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Table of Contents.

VOLUME XX.

OBSERVATIONS ON THE EFFERENT NEURONES IN THE ELECTRIC LOBES OF TORPEDO OCCIDENTALIS.

BY SHINKISHI HATAI,

(From the Biological Laboratory of the University of Cincinnati.)

CONTENTS.

I. MATERIALS USED AND TECHNIQUE EMPLOYED IN THE PRESENT INVESTIGATION.

For the present investigation, the efferent neurones in the electric lobes of *Torpedo occidentalis*, and the spinal ganglion cells from the mid-cervical ganglia of the adult white rat were used. The body weight of the rat was 141 grams. The torpedo material, which was generously furnished by Dr. Ayers, had been preserved with 10% formaline. To prepare this, a thin piece was cut from the lobe and transferred to distilled water for about six hours in order to remove all the formaline. After thorough washing with water, the material was transferred to 35% alcohol, where it remained about one hour, and then it was carried through graded alcohols and imbedded in paraffine in the usual way. The sections were cut 12 μ in thickness. For staining, a saturated aqueous solution of toluidin blue, and for contrast staining, an alcohol solution of erythrosin, were used.

The spinal ganglion of the white rat was preserved with the author's own mixture (formaline-acetic sublimate mixture) (*), and for staining, the reagents just mentioned were used.

II. Finer structure of the efferent neurones of the electric lobes in Torpedo occidentalis.

The efferent neurones of the electric lobes of *Torpedo occidentalis* are so large, more than 0.1 mm. in diameter, that they can easily be seen with the naked eye. Under moderate magnification, the cell bodies show numerous dendritic processes and the single axone is also visible in most cases.

The general form of the cell body is somewhat similar to that of the motor cells in the ventral horn of the spinal cord in man and the higher mammals. In most cases, the nucleus lies on the side of the cell-body towards the axis-cylinder process. The nucleus is nearly spherical, and very large in size proportionately to the cell-body (40–30 μ). The arrangement of the chromosomes in the nucleus is somewhat peculiar. They do not show minute spherules suspended in the delicate meshwork of the linin substance, but instead of that, irregular large masses which fill up meshes of the linin.

The nucleolus is always visible and lies at one pole of the nucleus. Curiously enough, the nucleolus, as a rule, lies in the same relative position in all the cells of a given section.

Under the higher magnification, the internal structure of the cell-body shows a fibrillar arrangement of the cytoplasm. The nature of this fibrillar structure will be discussed later on. In this chapter, only the general arrangements of these fibrils will be described.

Briefly speaking, the cell-body, except the nucleus presents everywhere a fibrillar arrangement of the cytoplasm. The following descriptions apply to the serial sections of one cell (102 μ in diameter, and 60 μ in thickness), and give a general idea of the structure above mentioned.

(*) Hatai, S.— Finer structure of the spinal ganglion cells in the white rat.—Jour. of Comp. Neurology, Vol. XI, No. 1, 1901.

Fig. 1 is a section passing through the periphery of the cell-body. In this figure, the dendritic processes are shown, but not the neuraxone. The position where the neuraxone will arise in the sections is marked by *A*. The fibrillar bundles which come from all dendritic processes of one side of the cell-body (*a*) take a curving course toward the axone hillock, thus forming an arrangement like an inverted U. Other fibrillar bundles come also from the dendrites on the other side (*b*) and take the same course toward the neuraxone. The dotted areas are interpreted as the cross-sections of the similar fibrillar bundles which, running through the cell-body in different directions, are therefore cut at different angles. In this figure, the fibrillar bundles connecting the dendrites with each other are shown very poorly.

Fig. 2 is the section nearer the center of the cell-body and follows Fig. 1. In this figure, the four dendrites are shown clearly, and the localities of the neuraxone is indicated by "*A*," although it does not appear at this level. The fibrillar bundles which form the neuraxone come from each of the dendrites. The dendrites themselves have close relations with each other by means of the connecting fibrillar bundles passing between them. The nucleus is surrounded by the fibrils coming from one of the dendrites (*c*). The fibrillar bundles which come from the dendrites (*d*) also take a part in investing the nucleus. The cross-sections of the fibrillar bundles show as clearly separated groups.

Fig. 3 is a section passing through the middle of the nucleus and follows Fig. 2. In this figure, the nucleolus is visible. The fibrillar arrangements are slightly different from those in the figures already given. In this section the fibrils do not form large bundles, but are divided into smaller strands and interwoven. The intimate connections between the dendrites are clearly shown. The nucleus is also surrounded by the bundles of the fibrils, which come from some of the dendrites. As a rule, in this level the fibrillar bundles near the nucleus are short, because bundles are, for the most part, cut more or less at right angles to their long axis. This suggests that the fibrillar bundles converge towards the nucleus. The peculiar arrangement of the fibrils near the

nucleus has been described as "vortex" or "spiral," or sometimes "Gitterähnliche Anordnung." On the contrary, the fibrillar bundles at the periphery present comparatively long sections. In this section, the neuraxone is not yet shown.

Fig. 4 is a section of the cell-body at another level. In this figure, three dendrites, nucleus, and neuraxone are clearly shown. The neuraxone "*A*" lies at one corner of the base of the rectangular cell-body. An intimate connection of each dendrite with that of the other, and also of all the dendrites with neuraxone is clearly shown in this figure. A curious arrangement of the fibrils is noticeable very near the axone hillock, where the fibrillar bundles have a beautiful spiral arrangement. This spiral arrangement is produced by the fibrils coming from various dendrites as is shown in the illustration. In this figure, connecting fibrils between the dendrites (*a*) and (*c*) are shown very clearly.

Fig. 5 is a section passing through the periphery of the side opposite to that shown in Fig. 1. In this figure, four dendritic processes are plainly shown — one from each corner of a somewhat rectangular-shaped cell-body. The position from where the neuraxone will arise in other section is marked by "*A*." A clear oblong space near the center of the cell-body is the place where the nucleus lies in the other sections. The fibrillar bundles which come from the dendrite (*a*) run towards the dendrites (*c*, *d*) along the one side of the nucleus, and finally enter the dendrites (*c*, *d*). Along the course, a few small fibrillar bundles diverge towards the periphery of the cell-body. The fibrillar bundles which come from the dendrites (*b*) run toward the dendrites (*c*, *d*) in a somewhat similar manner to those from the dendrite (*a*). In this case, the fibrillar bundles divide into two branches at the nucleus and after encircling the nucleus, they enter in the dendrites (*c*, *d*) and become continuous with those from the dendrite (*a*). From the base of the dendrite (*b*), small fibrillar bundles are distributed toward the neuraxone. From the dendrites *c*, *d*, the bundles of fibrils arise, and run toward the neuraxone. Along their course, these bundles are increased by the addition of numerous bundles of fibrils which come

from the periphery of the cell-body to form the yet larger bundles found in the axone hillock. The dendrites *a* and *b* are subdivided into two branches. In this case the branches are also connected by a few fibrils. These branches which are divided from the main dendrites (*a*, *b*,) receive fibrils from various regions of the cell-body.

From the above description, two important relations are evident: (1) That each dendrite is connected by the fibrillar bundles with several and possibly all the others, and (2) in each case, the nucleus is partially surrounded or encircled by the fibrillar bundles, on their way from the dendrites to enter into the neuraxone.

As a rule, the fibrils in the dendrites are very conspicuous, presenting long continuous lines, while in the cell-body they take tortuous or irregular courses, so that the cross-section of the cell-body presents minutely dotted areas, representing the cross-section of the bundles. From this, it is inferred that the entire course of some of the bundles must be very complex.

Fig. 6 is a diagram reconstructed from the serial sections of the cell-body in order to depict schematically its structure and to show the fibrillar tracts distributed throughout it. Let us take any one of the dendrites from the Fig. 6, and trace the lines which represent the fibrillar bundles. In the dendrite (*b*), black continuous lines present the out-going fibrillar bundles, while dotted lines in the same dendrite represent the in-coming fibrillar bundles from other dendrites. If we trace one of the black lines (3), it enters into the dendrites which lie in both sides, and other black lines (1) run toward the nucleus and partially encircle it. The fibrils continue from the nucleus toward the axone and finally enter into the axis cylinder. In the remaining dendrites, the fibrillar tracts are just the same in their distribution with those of dendrites (*b*).

In some cases, the fibrillar bundles which run from the dendrite not only enter into the dendrites which lie nearest on both sides, but they also connect with other dendrites further distant (2). In the cross-section of the cell-body, we notice very often the following appearance: The neighbor-

hood of the nucleus is composed of peculiarly arranged fibrils, forming a "spiral" or "swirl." These appearances are caused by the fibrils, which take very irregular courses and partially encircle the nucleus in a tortuous manner.

III. Finer structure of the ground substance of the spinal ganglion cells in the adult white rat.

It remains to discuss the real nature of the fibrillar structures mentioned above, and to this end the structure of the ground substance of the nerve-cells must first be considered.

Concerning the structure of the ground substance in nerve-cells, two main views are held: the "fibrillar" and "non-fibrillar" structure. The former theory may also be subdivided. One view is represented by the theory of Bethe (*) who regards the ground substance as composed of "Peri Fibrillär Substanz" and "Fibrillen." The so-called Fibrillen are independent individuals distributed throughout the cell-body in a certain way, where they neither anastomose nor branch. Another fibrillar theory is that of Apàthy (1). According to this author, the primitive neurofibrils are to be distinguished by means of special technique, in the nerve-cells as Bethe describes. These fibrils however, are not isolated, but are connected with each other by means of delicate branches, thus forming a very complicated anastomosis within the nerve-cells.

The non-fibrillar theories may also be divided into two groups, represented by the theory of Apàthy (1), Nansen (2), Bütschli (3), etc. Nansen holds the view of primitive tubular structure of the formation of the ground substance of the nerve-cells, that is, the ground substance is entirely composed of extremely small tubules which are directly continuous with the neuraxone.

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*) Bethe, A.—Über die Primitiv Fibrillen in den Ganglien-zellen von Menschen und Wirbelthieren.—Arch. für Mikrosk. Anat., Bd. 51.

(1) Apàthy.—Das leitende Element des Nervensystems, u. s. w.—Mitheil. d. Zoolog. Station zu Neapel, B'd XII, '97.

(2) Nansen, F.—The structure and combination of the histological elements of the central nervous system.—Bergen, '87.

(3) Bütschli.—Investigations on microscopic forms and on protoplasm.—'94. Translation to English.

Bütschli, Held (1), Van Gehuchten (2), Von Lenhossek (3), Ramon y Cajal (4), Marinisco (5), Ewing (6), a. o., hold the view of reticular or spongy formation of the ground substance, stating that the fibrillar structure described by others are not true fibrils but rows of fine granules which form the reticular arrangement of the ground substance.

The writer's observations on this subject are as follows: The ground substance of the spinal ganglion cells of the white rat exhibits a reticular structure as shown in Fig. 7. The meshes of the reticulum are very small but conspicuous. The size and form of the meshes vary. Generally, in the clear zone at the periphery of the cell-body, the meshes are always larger and more conspicuous than in the remaining part. In the neighborhood of the axone hillock the meshes are not only much diminished in size, but also they are much elongated along one axis. Around the nucleus, the meshes reach a minimum size. The form of the reticulum at the periphery shows meshes of a somewhat polygonal shape, but in the remaining part of the cell these meshes are elongated, especially around the nucleus and near the neuraxone. Upon examining with a higher magnification, the protoplasmic threads or filaments which forms the reticulum, we see that it is not smooth but has a somewhat varicose appearance, due to the presence of small bead-like arrangements on the course of the filaments. This bead was called by Held (*) a "neurosome," who discovered the occurrence of the neurosome not only at the connecting point of the net but also inside the net. The writer noticed the occurrence of these structures not only at the connecting points of the net but also in the course of the filament, but could not find them inside the reticulum.

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(1) Held.—Beiträge zur Strukturen der Nerven-zellen und ihren Fortsätze.—Erste Abhandlung. Arch. für Anat. und Entwickelungs. Anat. Abth., '95.

(2) Van Gehuchten.—Anatomie du systèm nerveux de l'homme.—Lauvain, 1894.

(3) Von Lenhossek.—Feinere Bau des Nervensystems.—'95. P. 147.

(4) Cajal.—Estructura del protoplasma nerviso.—Revista trimestral micrografica, Vol. I, fasc. 1, '96.

(5) Marinisco.—Pathologie gènèrale de la cellule nerveuse.—La Presse Médicale, '97.

(6) Ewing.—Studies on ganglion cells.—Arch. of Neurol. and Psychopathol., Vol. I, No. 3. '98.

(*) Held.—Loc. cit.

This bead or neurosome has peculiar chemical affinities for the staining fluids. Eosin or erythrosin stain this element very deeply, so that it can easily be distinguished from the rest of structures. The fine filament joining these beads seems to be slightly different from the neurosome itself, as is shown by a slightly different staining reaction. It seems, indeed, that these neurosomes are a highly differentiated portion of the protoplasm which forms the reticulum.

The form and size of the neurosomes are different in different localities, as has been already described by Held. These structures are especially numerous within the axone hillock and intracellular extension of the axone. At the periphery of the spinal ganglion cells, the individual meshes of the reticulum are so large that the neurosomes are less crowded, hence, in this region, they are scattered very irregularly. But on the contrary, in the remaining parts of the cell, the meshes of the reticulum are elongated in shape and the rows of neurosomes become more crowded together, thus giving the fibrillar appearence. At first glance, this arrangement of neurosomes looks very much like the fibrils which have been described by many authors. Careful observations, however, show that these lines appearing like fibrils are composed of a row of minute beads arranged serially. Moreover, these pseudo-fibrils are connected by protoplasmic threads, thus forming the reticulum. This structure is shown in Fig. 7. Around the nucleus these neurosomes form somewhat concentric lines in a very beautiful manner. But gradually the figure becomes irregular as the reticulum approaches the periphery. This is the appearance generally found in the spinal ganglion cells. Sometimes the cell shows different arrangement of neurosomes, namely, concentric lines at the periphery but not in the neighborhood of nucleus. Still other variations in arrangement are found.

Graf (*) noticed the fibrils which are composed of a row of minute beads, in the Purkinji cells of human cerebellar cortex. He said: "The cytoplasma show the most beautiful fibrillar structure that I have ever seen. The fibrillæ are

* Graf, A.—On the use and properties of a new fixing fluid (chrom-oxalic.)—Bull. of Pathol. Institute of the New York Hospitals, '97. Vol. II, p. 386.

exceedingly fine and are very regularly arranged in the cell-processes and on the surface of the cell, whereas they form a more intricate network in the center of the cell, especially around the nucleus. By closer observation of a favorable spot (the best places are where the stain is not very intensive) we notice that the finest cytoplasmic fibrillæ are not smooth, like smooth muscle fibrils, for instance, but are composed of a row of minute beads closely arranged in single file."

Held believes that the fibrils, according to some investigators, are in reality identical with rows of neurosomes. He hints that some of the fibrils represent bands of neurosomes; other fibrils described by Flemming are bundles of cytospongium.

My own observations support Held's suggestion. My preparations show sometimes exactly the fibrillar structure described by Graf, and I find this condition in the efferent neurones of the Torpedo, as well as in the spinal ganglion cells in the white rat. These fibrils can always be resolved into rows of neurosomes.

Another important point is, that the meshes of the reticulum in the cell-body become more and more elongated toward the axis cylinder. Thus it looks as if the fibrils are radiating from the axone around the nucleus.

The peculiar character of the region from where the axis cylinder originates was first described by Schäffer (1).

This region of the cell-body he called the "axone hillock." It is admitted by most investigators that the axone hillock, as well as the axis cylinder, show a parallel arrangement of cytoplasm. The writer notices also these arrangements of fine cytoplasmic threads, which carry the neurosomes, showing a convergent arrangement toward the axis cylinder. In this region the meshes of the reticulum are very small, but careful examination shows that the axone hillock, as well as axis cylinder, are composed of an altered reticulum.

The arrangement of neurosomes, except in the axone hillock, is not the same in all nerve-cells, but differs according to the type of the cells.

(1) Schäffer, K.— Kurze Anmerkung über die Morphologische Differenz des Axen Cylinders in Verhältnisse zu dem Protoplasmatischen Fortsätze bei Nissl's Färbung.—Neurol. Centralbl., Leipzig, Bd. XII, '93, S. 849–851.

In the motor ganglion cells in the anterior horn of the spinal cord, the neurosome presents quite a different arrangement from that of spinal ganglion cells. In the former group the meshes of the reticulum do not show the honey-comb form, but an elongated shape. The cytoplasmic thread carries a great number of neurosomes, which form straight chains. These chains run parallel to the periphery toward the dendrites, as well as toward the axis cylinder. Around the nucleus, however, these chains have the arrangement found in the spinal ganglion cells.

The Purkinjii cells in cerebellar cortex in the white rat show still a different arrangement of neurosomes. In these cells the neurosomes accumulate at the base of the main dendrites, showing very intricate arrangement. But near the entrance of the dendrites the irregular chains rearrange themselves, forming a regular line of neurosomic fibrils. The remaining part of the cell-body show nearly the same arrangement as that of the spinal ganglion cells.

IV.—Remarks concerning the structure of the ground substance in nerve cells.

As has been mentioned already, the ground substance of the spinal ganglion cells of the white rat presents very clearly the reticular structure. This structure, however, is altered by the growth of cell-body; for example, the prolongation of the axis cylinder from the cell-body is accompanied by an elongation of the primitively polygonal meshes of the reticulum, thus giving a fibrillar appearance to the ground substance.

The same holds true in the case of the Torpedo. The apparent fibrils result from alterations in the reticulum, and, therefore, should not be compared to those of Bethe's. Although, in the case of the Torpedo, the reticulum is hard to see, yet it is sometimes clearly demonstrable in thin sections properly stained.

In the spinal ganglion cells of the higher mammalia, except in Dogiel's second type of cells, the cell-body sends off only one prolongation, while in the case of Torpedo, the efferent

neurones of the electric organ give numerous processes from the cell-body. In the former case, the meshes of the reticulum are changed gradually from a regular polygonal form to those much drawn-out in the axone hillock. In the case of the Torpedo, however, the arrangement of the reticulum is modified not only toward the axis cylinder, but in every part of the cell-body from which dendritic processes arise. The appearances in Torpedo can be explained as a result of the growth changes of the cell-body. Judging from what we find in the rat, we assume in the first place the spinal ganglion cell to be a spherical mass filled by the wide meshed reticulum. For the same reason we assume that this spherical mass is pulled out at each point where there is a dendrite, and thus modified as it is where the neuraxone is formed from the axone hillock. As a result, the primitive polygonal meshes are transformed mechanically by the growth changes and thus give rise to the fibrillar appearance. If numerous processes are formed by the cell, as in the case of Torpedo, then the resulting appearance is quite complex. But the principle of its formation is the same as in the more simple spinal ganglion cell. The so-called fibrillar arrangement in the writer's preparation is thus explained:

V.—Summary.

1. The efferent neurones of the electric lobes of *Torpedo occidentalis* present a fibrillar appearance of the ground substance.

2. This appearance, however, is due to an alteration in the shape of the meshes of the reticulum, and, therefore, it cannot be compared with the fibrils described by Bethe, Apàthy, and others.

3. The meshes of the reticulum, which are regarded as the primitive by the present writer, are altered by the growth of the cell-body where the processes, both axone and dendrite, arise and become extremely elongated in these branches.

4. Gradations from the primitive shape of the meshes to the altered form which appears fibrillar, are clearly visible in the spinal ganglion cells of the white rat.

VI.—ILLUSTRATIONS. (Plate I.)

FIG. 1–5—Five serial sections from a single efferent neurone in electric lobe of *Torpedo occidentalis.* Mean diameter of the cell-body (120 μ x 83 μ); of the nuclei (37 μ x 34 μ).

FIG. 6—Diagram showing the fibrillar arrangement of the efferent neurone in an electric lobe of *Torpedo occidentalis.*

FIG. 7—Spinal ganglion cell from the mid-cervical ganglia of the adult white rat. Cell-body (41 μ x 30 μ); nucleus (15 μ x 15 μ).

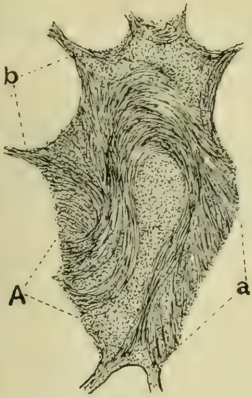


Fig. 1.

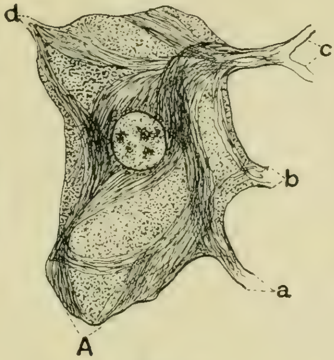
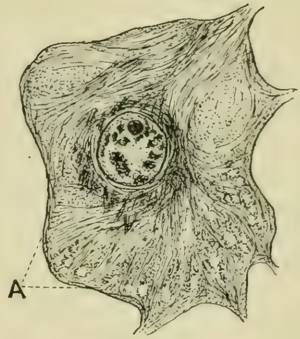


Fig. 2.



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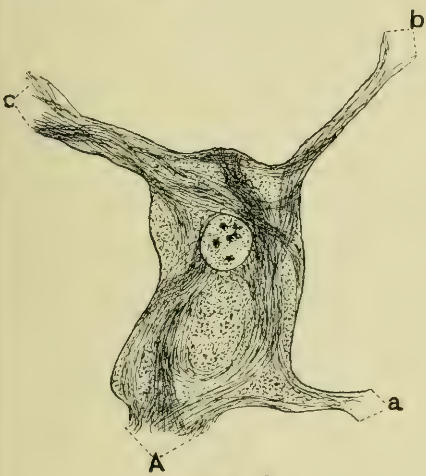


Fig. 4.

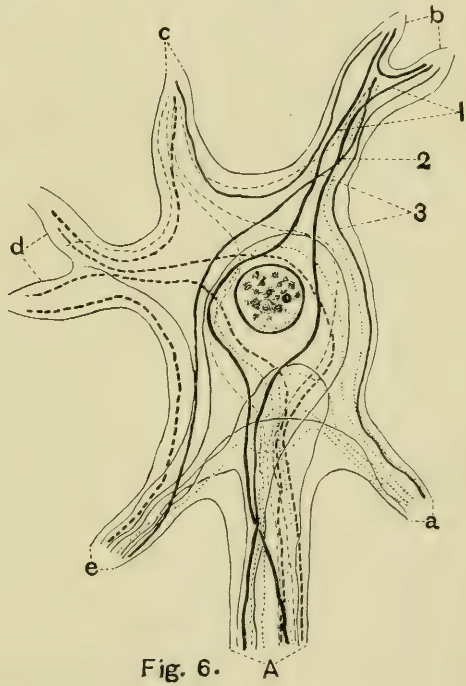


Fig. 6.

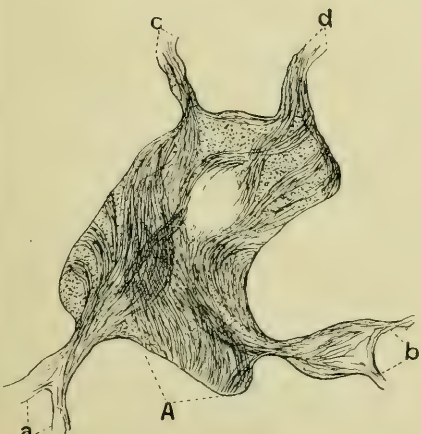


Fig. 5.

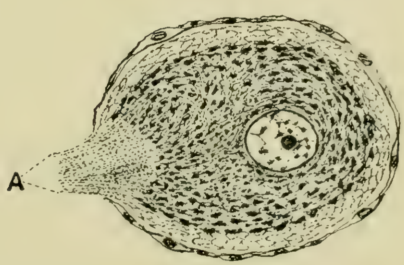


Fig. 7.

AN INVESTIGATION OF THE VASCULAR SYSTEM OF BDELLOSTOMA DOMBEYI.

The *Cyclostomata* derive their interest and importance from the fact that they are not only the lowest of the *Craniata*, but also possess many structural features which are undoubtedly ancestral in their character. As Dr. Ayers has maintained, too little attention has been paid to this class, especially to the Myxinoid division. With the exception of Johannes Müller's "Vergleichende Anatomie der Myxinoiden" (published 1834–1842), the Myxinoids, especially Bdellostoma, have scarcely been touched. A closer examination of the anatomy of the blood-vascular system of Bdellostoma, and a discussion of a few points concerning its comparative anatomy in the light of our present knowledge, is the purpose of this paper.

The material used in the following investigation included several injected specimens, and a large number of uninjected specimens of *Bdellostoma dombeyi* collected by me during the summer of 1897, in the Bay of Monterey, at Pacific Grove, California. Carmine-gelatine was used for injection, and the specimens were preserved in alcohol-formalin mixture (95 per cent alcohol, 6 parts; 2 per cent formalin, 4 parts). For comparison I have used specimens of *Bdellostoma forsteri* (from the Cape of Good Hope), *Petromyzon*, *Myxine*, etc., belonging to Dr. Ayers, under whose direction the following investigation was made.

THE HEART.

(Figures I, II, III, also, IX, X, XIV).

The heart is composed of three chambers — sinus venosus, auricle, and ventricle.

The *sinus venosus* (Figs. I, II, S), (gemeinschaftlichen Körpervenenstamm of Müller), is that part of the heart which

receives the blood from the venous system. It is an elongated thin-walled sac, about 2 cm. in length, situated a little to the left of the median line, just above the anterior lobe of the liver, and between the sheets of mesentery which form the hepatic ligament. The larger posterior portion lies just below the alimentary canal, and anterior to the gall cyst. The smaller anterior portion lies beneath the auricle (A). The sinus lies outside the pericardial cavity, but is partially enclosed between the layers of the mesocardium. It is dilated posteriorly, being somewhat quadrilateral in outline, and compressed laterally. In this region the sinus receives, on the right side, the anterior and posterior hepatic veins (ha, hp). At the posterior extremity it receives the posterior common cardinal trunk (pcc). Anteriorly, it receives, on the left side, the left anterior cardinal vein (acl). The narrow anterior portion of the sinus venosus receives the inferior jugular vein (jv) just anterior to the sinu-auricular aperture, which lies in the dorsal wall near the anterior end.

The *auricle* (Figs. I, II, III, A) lies immediately above and anterior to the sinus. It occupies the left portion of the pericardial cavity, and is surrounded by the pericardium (its relations to which will be described in detail later). The auricle is the largest of the cardiac divisions, and, when expanded, almost completely fills the left pericardial cavity. When contracted, however, it is smaller than the ventricle, since it is very thin-walled. It is an elongated sac, irregular in shape, and flattened dorso-ventrally. The exact position and extent varies considerably in different specimens. It is somewhat irregularly convex, except the inner and upper walls. These are usually concave, on account of being closely apposed to the ventricle during life. The auricle usually lies for the most part on the left side of the alimentary canal. Posteriorly, the auricle is closely connected ventrally with the sinus, communicating with it through the sinu-auricular aperture. On the right side it communicates with the ventricle through a short canal, the *ductus auricularis*. (See Figs. I and II.) This duct, though well marked in some specimens, is obscured in others by the approximation of the auricular and ventricular walls. It is really a constricted portion of the auricle at the auriculo-ventricular aperture. The margin of the auricle

behind this duct usually projects as a lateral pocket into the right pericardial cavity. The auricle is attached ventrally and internally (*i. e.*, to the left) by the mesocardium. The anterior and posterior extremities of the auricle, however, project freely into the over-lying pericardial cavity.

The cavity of the auricle (Fig. III) is very irregular. Beside the three pocket-like spaces (anterior, posterior, and lateral), the cavity is made irregular by a network of muscular trabeculæ which project from the walls, and sometimes across the cavity. The auricle has two openings. The afferent, or sinu-auricular aperture, is in the posterior portion of the floor. On viewing the floor from above, the long narrow slit-like opening is seen extending diagonally from side to side. The opening is guarded by two thin membranous valves (Fig. III, sav), whose free margins readily allow the influx of blood, but effectually prohibit its reflux. A short distance anterior from the sinu-auricular opening we find the auriculo-ventricular aperture, an oval foramen, on the right side in the duct previously described. This aperture is also guarded by a pair of valves, semi-lunar in shape, one lying anterior and the other posterior to the opening. These valves are smaller but stronger than the sinu-auricular valves. During the flow of blood from the auricle into the ventricle they lie flattened against the sides of the duct, with their free margins extending toward the ventricle and offering no resistance to the flow of blood. During the ventricular systole the valves prevent the reflux of blood by the apposition of their free margins in the median line, completely closing the channel.

The *ventricle* (Figs. I, II, III, V) is an ovoidal sac, slightly elongated and flattened dorso-ventrally. The lateral margin on the left side, next to the auricle, is less convex than that on the right. The ventricle is nearly in the median line of the body, just below the alimentary canal. It lies to the right of the auricle, somewhat ventral and anterior to it. The wall of the ventricle is much thicker than that of the auricle, and encloses a cavity shaped like a Scottish bag-pipe (See Fig. III). The inner surface of the wall, like that of the auricle, is marked by projecting muscular trabeculæ. There are two openings into the ventricular cavity. The afferent,

or auriculo-ventricular is an oval foramen situated near the posterior end on the inner side. It corresponds to the end of the short ductus auricularis already described. The foramen ordinarily measures about a millimeter in diameter in individuals of fifty centimeters length. The afferent or aortic aperture lies at the anterior extremity of the ventricle. It is nearly circular in outline and is likewise guarded by a pair of strong semi-lunar valves, one dorsal and one ventral. These are the strongest and thickest of the cardiac valves. They contain much elastic tissue, and are continuous with the walls of the aorta at its base. Their action is similar to that of other valves.

Pericardial Cavity.

The alimentary canal in Bdellostoma is suspended from the mid-dorsal line of the body wall by a mesentery, which is formed by the reflection of the lateral peritoneal sheets. (See Fig. IV., m.). Ventral to the alimentary canal, in the anterior abdominal region, the liver is likewise enclosed by a continuation of the same mesentery. (See Fig. V, L). Above the anterior lobe of the liver, the lateral peritoneal sheets do not meet above the alimentary canal to form a distinct mesentery. They are widely separated, and in the space between them the pericardial cavity is formed, just above the anterior lobe of the liver. The relations of the peritoneal and pericardial cavities are shown in diagram VI, which represents a cross-section through that region. For convenience of description, we may conceive of the pericardial sac as formed by an evagination of the peritoneal membrane on the right side into the space above the anterior lobe of the liver, and below the alimentary canal. The sac formed by this evagination is in turn *invaginated* by the pushing in of the heart (V) from below. In this way the pericardial membrane becomes arranged to form a double wall made up of two layers — an outer (O), or parietal layer, which encloses the pericardial cavity (pcc), and which is reflected to form the inner, or visceral layer (i), which immediately invests the heart. By the approximation of the pericardial layers, where they are reflected over the heart, a ventral cardiac ligament, the *mesocardium* (cm) is formed. The mesocardium partially separates the general pericardial cavity into two unequal divi-

sions, right and left. These two cavities communicate freely with each other dorsally (above and behind the heart), but are entirely separated ventrally. The right pericardial cavity, which is the larger, remains in free communication with the peritoneal cavity through the *pericardio-peritoneal foramen* (pcf). The heart has therefore exactly the same relation to the pericardium and the pericardial cavity as the intestine has to the peritoneum and the peritoneal cavity. There is only this difference, that the mesentery is *dorsal* to the intestine, while the mesocardium is *ventral* to the heart.

The right pericardial cavity may be described approximately as an elongated lenticular cavity, 2–3 cm. long, flattened dorso-ventrally, and lying just above the anterior portion of the anterior lobe of the liver. The anterior end of the cavity is larger and extends somewhat toward the right. It includes that portion of the cavity which contains the ventricle. The posterior end of the cavity is narrower, and extends backward and toward the left. The right pericardial cavity, as a whole, is bounded above by the dorsal body wall; below by the anterior lobe of the liver; internally by the mesocardium and the intestine (which it partially surrounds); and externally by the reflected peritoneum, which lies for the most part against the dorso-lateral body wall. An imperfect septum, the *portal septum*, complete only in the posterior region, is formed by the reflection of the roof into the right pericardial cavity. It extends parallel to the long axis of the cavity, and partially divides it into two chambers — a smaller *outer* and a larger *inner* chamber. This double-layered portal septum in the middle portion surrounds the portal heart; anteriorly, the anterior portal vein runs between its walls; and posteriorly it surrounds the common portal vein.

The *outer chamber* of the right pericardial cavity lies external to the portal septum. It is a narrow cavity, about 2–3 cm. in length, lying parallel to the inner chamber. It communicates with the inner chamber below the septum throughout almost its entire length. Only the extreme posterior portion of the outer chamber, into which the lateral wall of the alimentary canal projects, is completely separated by the septum from the inner chamber. In the posterior region the outer chamber communicates laterally and externally with

the general peritoneal cavity, through a narrow slit about 1–2 cm. in length — the pericardio-peritoneal foramen. (See Figs. VI, X, XIX, pcf). The direction of the slit is not quite longitudinal, but extends slightly outward anteriorly. The lower margin of the foramen is formed anteriorly by the fold extending upward from the liver (hepatic ligament) (See Fig. VI). Posteriorly, the slit borders on the lateral wall of the alimentary canal. The upper margin of the slit is formed posteriorly by the body wall and anteriorly by a reflection of the peritoneum from the wall. Through the pericardio-peritoneal foramen passes the supra-intestinal vein closely attached to the lateral wall of the intestine. The anterior extremity of the *right mesonephros* extends through the foramen, projecting from the inner side of the roof. The floor of the outer chamber is formed anteriorly by the upper surface of the anterior lobe of the liver; posteriorly, by the fold extending from the upper surface of the lobe to the lower margin of the pericardial foramen. The roof of the outer chamber is in direct contact with the body wall. External to the portal heart, toward the anterior end of the chamber, the *right pronephros* projects downward and outward into the cavity, pushing the pericardium before it. Just behind the pronephros, and above (outside) the pericardium, along the inner margin of the chamber, lies the anterior end of the mesonephros, which extends backward through the pericardial foramen, as described. In the posterior region the outer chamber lies against the right side of the intestinal wall. Along this wall a fold of the pericardium extends from the pericardial foramen to the posterior end of the portal heart. This fold encloses the *supra-intestinal* vein. (See Fig. XIII.)

The *inner chamber* of the right pericardial cavity lies internal to the portal septum, and encloses the ventricle of the heart. It is much larger than the outer chamber, being of about the same length, but wider and deeper. The inner chamber is situated slightly ventral to the outer. Anteriorly, the chamber is about ¾ cm. deep. Posteriorly, it becomes shallower and narrower, terminating just anterior to the gall bladder, and above the anterior lobe of the liver. On the left side the inner chamber forms a blind sac into which a

lobe of the auricle projects. The roof of the inner chamber is in contact with the ventral surface of the alimentary canal. The floor lies upon the dorsal surface of the anterior lobe of the liver. The anterior wall lies against the connective tissue surrounding the last gill pouch on the right side. The external wall is formed by the portal septum, which is incomplete ventrally, leaving an extensive communication with the outer chamber. The inner wall is formed by the mesocardium, which is also incomplete. Above the mesocardium is a narrow longitudinal slit (about 1 cm. in length) through which the right and left pericardial cavities communicate. The ventricle of the heart occupies the anterior portion of the inner chamber. The double-layered mesocardium passes upward and outward from its attachment, soon dividing into two sheets which form the inner pericardial layer immediately surrounding the ventricle. (Fig. VI.) Anteriorly the inner pericardial layer becomes continuous with the outer, forming no pericardium. In this way the anterior end of the ventricle is *not covered* by the pericardium, but lies *outside* the pericardial space. The mesocardium is attached ventrally to the left margin of the anterior lobe of the liver. Posteriorly it encloses the sinus and veins opening into it.

The left pericardial cavity lies on the left side of the mesocardium, somewhat dorsal to the right cavity. It is a small elongated sac, which closely surrounds the auricle. The roof is in contact with the alimentary canal internally and the dorsal body wall externally. The floor and external walls touch the latero-ventral body wall. The inner wall is formed by the incomplete mesocardium, leaving the right and left pericardial cavities in communication dorsally. The exterior wall abuts against the postero-dorsal wall of the oesophago-cutaneous duct. Posteriorly, the cavity ends as a short blind pocket. From the roof the left pronephros and the left anterior cardinal vein project into the cavity, pushing the pericardium before them. The mesocardium extends into the left pericardial cavity and surrounds the ventricle on the right side. The postero-internal angle of the auricle often extends through the slit-like foramen above the mesocardium, and lies in a pocket within the right pericardial cavity. This relation is not constant, however.

Arterial System.

The *ventral aorta* (Figs. X, XVIII, Av.) consists of a principal median trunk, which divides anteriorly into a pair of lateral branches. The main trunk lies in the median line, just above the ventral body wall and below the pharynx. The length is about 3 cm. The lateral branches are a little longer. It extends from the anterior end of the ventricle to the posterior extremity of the "club-muscle." It lies between the last six or seven pairs of gills, and is imbedded in the peculiar brownish fatty connective tissue characteristic of that region. The median trunk of the aorta is nearly cylindrical in shape, but narrows slightly in caliber anteriorly. Posteriorly, at its junction with the ventricle, it is suddenly constricted. The relatively small opening from the ventricle is guarded by a pair of strong semi-lunar valves, as previously described. The short expanded portion of the aorta just beyond the constriction and behind the first gill branches represents the *bulbus aortæ*. This portion of the aorta is in contact ventrally with the dorsal surface of the anterior lobe of the liver.

The ventral aorta divides anteriorly into two branches (right and left) which pass forward, upward, and outward, along the dorso-lateral aspect of the posterior end of the club-muscle. The posterior end of the club-muscle, with reference to the point of branching, is variable, on account of the mobility of the former. The usual position is shown in Fig. X. But the muscle may be drawn forward, or even back below the point of division.

The *afferent branchial arteries* (Figs. X, XVIII, af. br.) rise on either side from the ventral aorta and its right and left branches. There are usually six or seven pairs arising from the median trunk, and from three to six pairs from the branches. Sometimes there is one more on one side than on the other, corresponding to the asymmetrical occurrence of the gills. The six or seven pairs from the median trunk are never symmetrically disposed. The last afferent branchial artery on the right side is always posterior to the corresponding left vessel. (See Fig. X.) The two pairs lying next anterior to the last are situated nearly opposite to each other,

while the remaining vessels from the median trunk are asymmetrical, the *left* vessels arising anterior to the corresponding vessels on the right side. The afferent branchial arteries arising from the right and left branches of the aorta are also asymmetrically placed, corresponding to the asymmetry of the gills. The afferent vessels vary in length, the anterior vessels being longer than those in the posterior region. Those from the main trunk are about 1–1.5 cm., while those from the lateral branches are 1.5–3 cm., increasing from behind forwards. The most anterior vessel is always the longest. In size they are all about equal. The direction of the arteries is external and slightly upward in the arteries from the main trunk, and forward, upward, and outward in those from the lateral branches. Each afferent branchial artery terminates on the postero-external wall of the corresponding gill pouch, just below the external gill passage.

The last afferent branchial artery of each side gives off a small branch a short distance from the gill. This branch possesses a lumen only at its origin, if at all. It soon becomes reduced to a slender string of connective tissue which becomes lost in the connective tissue around the "club-muscle." Attached to this string is a small spheroidal body, apparently made up of fibrous and fatty tissue. (See Fig. X, XIV.)

It may be remarked that in *Bdellostoma forsteri* this string may be traced from the branchial artery around to the dorsal aorta. The significance of these structures will be discussed later.

Branchial Circulation.

(Figs. VIII, IX, X, XIII.)

The gills of the Bdellostoma are lens-shaped pouches, compressed laterally, so as to be concave on the inner face and convex on the outer. The pouches are not circular in outline, but more nearly elliptical, being elongated dorso-ventrally. The gill, as a whole, has two faces and four borders—superior, inferior, anterior, and posterior. The anterior and posterior are usually indented so as to be slightly concave, instead of convex. The afferent gill passage enters at the middle of the concave *inner* wall of the gill. (Fig. XIX.)

The efferent gill passage is given off from about the center of the convex *outer* wall. (Fig. X.) The line through these openings I shall call the axis of the gill. The internal anatomy is complex. The mucous membrane of the inner walls is folded to form a number of plates which are parallel to the axis of the gill and extended radially toward the center. (Fig. IX.) There are about twenty large plates, and a large number of smaller ones. The latter extend only a short distance in from the wall, and fill in the spaces between the bases of the other gill plates. Each plate is thrown into folds, only moderately near the base, but to an extraordinary degree of complexity toward the center. In this way a large amount of respiratory surface is developed. The free central margin, like the attached base of the plate, is strong and only slightly branched. These parts seem to serve merely as supports for the extremely thin respiratory leaflets. The inner surface of the gill wall, and the thicker supporting parts of the gill plates are covered with a stratified epithelium. The delicate respiratory leaflets are covered with a thin pavement epithelium. Next to the epithelial membrane occurs a small amount of connective tissue surrounding the blood vessels. Externally, the wall of the gill pouch is composed of a double layer of striated muscle — the external layer of *circular* fibers, the internal of *longitudinal* fibers (parallel to the axis). Surrounding the muscular layer is a thin serous membrane, which lines the lymphatic peri-branchial spaces.

The general distribution of the blood vessels in the gills is as follows: The *afferent branchial artery* of each gill passes under the lower margin of each gill pouch, then upward over the convex outer gill wall, which it enters just below the external gill passage. Some small twigs are given off which supply the gill passage and the muscles of the gill wall. The afferent artery then divides into two branches which surround the opening of the gill-passage, forming an irregular "ring vessel." From this "ring vessel" several radial vessels, often dilated into sinuses, are given off which pass within the gill wall toward the peripheral margin. Branches are given off which extend along the attached margin of each gill plate, beneath the muscular layers of the gill wall. From these branches numerous smaller vessels pass directly into

the gill plate. Their general direction is parallel to the axis of the gill, and perpendicular to the walls of the gill pouch. These smaller vessels break up into capillaries, which ramify between the thin epithelial walls of the respiratory gill leaflets. In this region an extensive capillary network is formed, and anastomoses between the larger vessels are also common. Toward the opposite (*i. e.* the inner) attached edge of the gill plate, and in the free central margins, the capillaries again unite to form larger vessels. These efferent branchial vessels converge on the inner wall of the gill pouch in much the same way as they are distributed in the outer wall. They unite under the muscular layer into sinuses and vessels which finally unite to form the efferent branchial artery of each gill pouch. This vessel leaves the gill wall just above the internal gill passage. (Fig. XIX, ef, br.) A diagrammatic representation of the branchial circulation is shown in Figure XIII, which respresents the vascular distribution in a plane parallel to the gill axis. Figure IX shows a drawing of a section of an injected gill made perpendicular to the axis of the gill, and near its center. The low magnification fails to give an adequate idea of the great complexity in the formation of the gill leaflets. Figures VIII and XIV represent small portions of these leaflets magnified to show the capillary vessels, which are composed of a single layer of epithelial cells. The larger vessels have walls composed of three layers,—an outer layer of connective tissue, a middle layer of circular muscle fibers, and an inner simple endothelial layer.

The *efferent branchial arteries* (Figs. XVIII, XIX, XX, ef, br) arise from the inner face of each gill pouch, just above the internal gill passage (gpi). Each efferent vessel extends upward and inward toward the median line. In the posterior region each vessel ascends just behind a "gill constrictor" muscle, then turns forward immediately *above* it and joins the overlying common carotid just anterior to the muscle. There are never *two* efferent vessels for each gill-pouch, as is commonly the case in *Bdellostoma forsteri*. All the efferent branches of each side open into the corresponding lateral common carotid.

General Arterial System.

The *common carotid arteries* (right and left) posteriorly extend longitudinally along each side above the gills and beside the pharynx. (Figs. XVIII, XIX, XX, Car.) Externally, they connect with the efferent branchial arteries; and internally, by means of from four to seven short commissural vessels (comv) on each side, they communicate with the median dorsal aorta. These commissural vessels usually arise nearly opposite the fourth or fifth to the eighth or tenth pairs of gills. Posteriorly the common carotids are connected with the dorsal aorta nearly opposite each other, and a short distance behind the last pair of gills. Anteriorly they continue forward on each side of the pharynx, giving off numerous small twigs to this organ. Each carotid also supplies the club muscle with several branches. The most posterior pair of these branches seem to supply only that portion of the muscle connected with the longitudinal *retractor* fibers. The remaining branches supply the circular *constrictor* portion. The branches to the "club-muscle" run in the sheet of connective tissue which connects the muscle to the dorsolateral body wall on each side.

Just behind the cartilaginous "pharyngeal basket" of the branchial skeleton, each common carotid divides into two branches, the *external* and *internal* carotid arteries. Each external carotid passes forward and downward around and outside the pharyngeal basket and runs forward along the outer margin of the basal plate. Near the junction of the posterior with the anterior segments of the basal plate, a small branch is given off which passes upward and inward to the ligament attaching the dental plate (*ramus lingualis*). This branch supplies the dental plate but apparently not the muscles moving it. The main trunk of the external carotid then passes forward along the external margin of the basal plate on each side giving off small twigs to the lateral walls of the skull. Anteriorly it breaks up into a number of small branches, which supply the muscles and integument in the tentacular region.

Each *internal carotid* continues inward and forward just above the pharynx. (See Figs. XVIII and XX.) A rela-

tively large lateral branch is given off on each side which runs forward and supplies the muscles in the lateral region of the head. In one instance I traced this vessel (on the left side), forward under the lateral trunk muscles just outside the skull wall, under the hyoid arch, and out into the orbital region, sending a branch out to the skin, in the fibrous band of connective tissue just below the eye. The main trunk of the internal carotid joins the corresponding vessel of the opposite side in the median line just below the notochord and in front of the supra-pharyngeal plate. (See Fig. XX.)

The *vertebralis impar* (v), formed by the junction of the internal carotids, runs forward a short distance in the median line beneath the notochord, giving off branches to the brain and cranial wall. Passing below the cranium, just behind the pituitary sac, it divides into two lateral branches, right and left, which run forward on each side of the base of the cranium to the nasal and anterior head region.

The *anterior dorsal aorta* (Figs. XVIII, XIX, XX, Aa) is that portion of the median dorsal aorta which lies in, and in front of, the gill region. Posteriorly, it begins with the most posterior point of connection with the lateral carotids. It lies immediately above the pharynx, and below the notochord. In the gill region, the anterior dorsal aorta gives off four or five pairs of branches to the body wall (somatic branches). The posterior, three pairs of these usually pierce the overlying "gill constrictor" muscles. In the anterior gill region, the aorta curves slightly to the right, and continues forward beneath the right side of the notochord. In one instance it turned first to the left, ran forward two or three somites, then passed over to the right and forward as usual.

Anterior to the gill region it gives off in its course seven or eight pairs of somatic branches to the adjacent segments of the body wall. In general, an artery is given off to each alternate myoseptum on each side. Each somatic vessel divides into two branches, dorsal and ventral, whose course is the same as that of those to be described in the abdominal region (see Fig. XV). There are some variations in the distribution of the branches of the anterior dorsal aorta,

however. The arteries, like the corresponding myotomes, are not arranged in bilateral symmetry. The branches are given off *alternately*, especially in the anterior region. (See Fig. XX.) A short distance behind the junction of the internal carotids, the anterior dorsal aorta crosses over and joins the left internal carotid, just behind the origin of the lateral branch.

The *posterior dorsal aorta* (Figs. XII, XV, XVIII, XIX, XX, Ao), is the posterior continuation of the same vessel which anteriorly forms the anterior dorsal aorta. Beginning behind the junction with the lateral carotids, the posterior dorsal aorta gives off branches as follows:

(*a*) A pair of *somatic branches*, and usually a mesenteric twig to the intestinal wall.

(*b*) Twigs to the right and left *pronephros* (pnl, pnr). These may come off as separate twigs, but usually arise in common with somatic branches (Fig. XIX).

(*c*) The *coeliac artery* is a relatively large vessel. It occasionally gives off a twig to the left pronephros. It then passes downward between the sinus venosus and the alimentary canal (to which it gives off a small branch). The coeliac artery then proceeds along the common bile duct to the gall-cyst, which it supplies. Then it divides into two terminal vessels, anterior and posterior, which pass along the bile ducts to the anterior and posterior lobes of the liver. Here they break up into capillaries which supply these structures.

(*d*) *Mesenteric arteries* (Figs. XII, XV, XVIII, mes) are given off ventrally, which pass downward between the right and left posterior cardinal veins, in the mesentery, to the intestinal wall. Just above the intestinal wall they usually divide, one branch going to the right, the other to the left side of the intestine. Both branches pass to the left of the supra-intestinal vein, but pass one on each side of the vagus nerve, which lies in the median line just above the intestinal wall. There are about thirty mesenteric arteries, and they arise in a somewhat irregular manner. Often, however, they arise in couples, one a short distance behind the other (See Fig. XII).

(*e*) The *somatic arteries* arise regularly along the entire length of the dorsal aorta, anterior and posterior (Figs. XII,

XV, XVIII, XX, s). The somatic arteries, as a rule, alternate with the somatic *veins* on each side. (Fig. XII.) Those of the right and left sides are sometimes in pairs, opposite each other, but usually alternate, always corresponding to the arrangement of the myotomes on each side. The somatic arteries from the *anterior* dorsal aorta arise independently. Those from the *posterior* dorsal aorta usually arise by a short trunk in common with one or more renal branches (Fig. XII). Each somatic artery passes above the mesonephros, supplies it with one or more twigs, and then divides into two branches. (See Fig. XV.) The *dorsal* branch passes directly upward beside the notochord, supplying the lateral trunk muscles, and sending branches into the neural canal to supply the spinal cord. Then it passes up in the median longitudinal septum above the neural canal. It passes out to the skin of the dorsal region through the sheet of connective tissue which fastens the skin to the body wall.

The *ventral* branches of the somatic arteries correspond to the *intercostal vessels* of the higher vertebrates. (Figs. XII, XV, ic.) They pass outward along the roof and sides of the peritoneal cavity, between the lateral trunk muscles and the peritoneum. They pass along the septa between the myotomes, giving off many minute twigs to the adjoining muscles. (See Figs. XII, XV, ic.) Each "intercostal" passes along with (anterior to) the corresponding intercostal nerve (sn). After passing between two slime glands, which it supplies, each intercostal vessel gives off irregular branches to the ventral rectus trunk muscle in the vicinity. The end piece of each vessel passes out into the skin in the neighborhood of the slime glands, and is distributed to the integument of the ventral and lateral regions of the body.

(*f*) *Renal branches* are supplied segmentally to the mesonephros along each side of the aorta. A portion of these are shown in Figure XII, (r). (cfr. also Figs. XVIII and XX.) These renal branches supply the segmental glomeruli along the inner wall of the mesonephros. The glomeruli correspond to the myotomes only in a general way, and not exactly. Usually two glomerular vessels, and one or more twigs to the dorsal and inner walls of the mesonephros, arise from a common trunk with a somatic branch. There is

much variation in this respect, however. Sometimes a somatic and one renal vessel arise together, and sometimes the renal vessels arise independently.

(*g*) The *genital branches* (Figs. VII, XVIII, XX, gen) arise from all the mesenteric arteries in the region of the testis in the male, and the ovary in the female. Occasionally branches arise independently from the dorsal aorta. The genital branches pass out in the genital ligament (a special fold on the right side of the mesentery). Soon after entering this fold the genital vessels, for the most part, unite to form a longitudinal commissural vessel. (Fig. VII.) From this vessel a large number of smaller vessels run out toward the testis or ovary, branching and anastomosing freely. A capillary network is formed in the membrane surrounding each ovum, or lobule of the testis.

Behind the cloaca, the aorta continues immediately below the notochord in the median line, but here, as might be expected, only the somatic branches are given off. On reaching the median ventral plate, the aorta divides into a right and a left branch, each of which passes backward on the corresponding side of the plate. Lateral branches are given off to supply the muscles and integument of the caudal region. In the caudal fin, small vessels run out distally corresponding to each fin ray.

General Venous System.

The *veins* of the Bdellostoma may be included under two separate systems—the *general* system, and the *portal* system. The general venous system is larger, including all those veins through which the blood flows into the sinus venosus. (Figs. X, XI, XVII, XVIII, S.) Anteriorly where it empties into the auricle, the sinus is narrow, and receives the *inferior jugular* vein (jv). Posteriorly, behind the auricle, the sinus is dilated, and receives on the left, the *left anterior cardinal vein* (acl.) anteriorily, and the common cardinal vein (pcc) posteriorly. On the right side enter the anterior and posterior *hepatic veins* (ha, hp).

Beginning with the general venous system in the head region, we find the *superficial anterior cardinal vein.* (Figs.

XVII, XVIII, scd) arising on each side of the head. It leaves the cranium just dorsal to the corresponding vagus nerve. It passes backward alongside the vagus, between the lateral trunk muscles, and the constrictors of the pharynx. In this region it receives the first eight or ten somatic veins. These somatic veins, like the somatic arteries (with which they alternate), arise from the skin and trunk muscles the entire length of the body. They correspond exactly to the somatic veins of the abdominal region shown in Figure XV, (s). They are each composed of a very short terminal trunk which is supplied by two branches, (1) a *dorsal* branch which collects the blood from the dorsal region of the integument, the spinal cord, notochord and muscles of the vicinity. It descends vertically at the side of the notochord, and on reaching the ventral surface of the dorsal body wall, joins with (2) the *ventral* branch, or "*intercostal*" vein. The intercostal veins, like the intercostal arteries, are distributed to the integument of the ventral and lateral regions of the body, and the ventral rectus muscle. In the gill region, the intercostals receive, in the region of the slime glands, occasional "pleural" branches from the connective tissue. Then after collecting the blood from the two adjacent slime glands, it passes between these along the intermuscular septum of the myotomes, on the ventral surface of the dorsal and dorso-lateral body walls. The intercostal veins lie just in front of the corresponding intercostal nerves. As before mentioned, the intercostal veins usually alternate with the intercostal arteries (Figs. XI, XII, XV, XIX, ic), especially in the abdominal region. In the pharyngeal region the arrangement is less regular, there being often two adjacent arteries or veins, and occasionally both an artery or vein on *one* intermuscular septum. (Fig. XIX.) After receiving the somatic veins from the head region, the superficial cardinal pierces the constrictor muscle and joins the *deep cardinal* vein.

The *deep anterior cardinal* vein (Figs. XVII, XVIII, dcd) arises from the integument and muscles of the anterior head region. It passes on each side between the pharynx and hyoid arch (just below the posterior process), then directly backward alongside the pharynx, internal to the constrictors,

receiving branches, and passing under the first branchial arch, but over the second. About 2–3 cm. behind the second arch it is joined by the *superficial cardinal* to form the *common anterior cardinal* vein.

The *common anterior cardinal* (or jugular) veins, right and left (Figs. XVII, XIX, acr, acl), pass backward and beside the pharynx, just external to the corresponding carotid artery, and internal to the vagus nerve. They receive four sets of branches: (1) somatic veins from the body wall; (2) pharyngeal branches, (ph), numerous small twigs from the wall of the pharynx; (3) "club-muscle" branches, from the "club-muscle;" (4) "pleural" branches from the connective tissue in the pharyngeal region. Anteriorly, the courses of the right and left anterior common cardinals are similar. Behind the "club-muscle," however, they are quite different.

The *left anterior cardinal* continues in the same general direction backward beside the vagus, and above the gills. It receives the usual somatic branches, and also a few "pleural" twigs from the connective tissue surrounding the gill pouches. It also occasionally receives twigs from the walls of the gill passages and oesophago-cutaneous duct. Posteriorly (Fig. XI, acl), it forms a slight projection from the roof into the left pericardial cavity, as before described. It passes between the left pronephros, from which it receives a twig, and the alimentary canal, and empties into the antero-lateral angle of the dilated posterior portion of the sinus venosus.

The *right anterior cardinal*, on the other hand, toward the posterior end of the "club-muscle," leaves the pharyngeal wall, passes downward toward the posterior end of the "club-muscle," and crossing over toward the median line, empties into the *inferior jugular* vein. (Fig. XIX, jv) The remaining area corresponding to that supplied by the left anterior cardinal on the other side of the body is supplied by the portal system.

The *inferior jugular vein* (Figs. X, XVII, XVIII, jv) arises from the posterior end of the "club-muscle," from which it emerges on the ventral surface. It passes backward a little to the left of the median line, immediately over the ventral body wall. After receiving the right anterior cardinal

vein, it continues backward a little below and to the left of the median ventral aorta. (Fig. X.) It receives a varying number of branches from the body wall. It also receives several small "pleural" twigs from the connective tissue and gill passages, including the oesophago-cutaneous duct and the adjoining pharyngeal wall. Finally, the inferior jugular vein empties into the anterior end of the sinus venosus, just in front of the sinu-auricular aperture.

The *posterior cardinal veins* arise in the caudal region from small twigs which form two small veins. These lateral veins accompany the arteries on each side of the cartilaginous median ventral plate in the caudal region. (Fig. XVII.) They unite to form the *median caudal vein* (caud), which runs forward immediately beneath the caudal artery. The caudal vein, at its posterior end, is dilated to form a small sinus just in front of the median ventral plate. Laterally, the caudal vein receives, on each side, the somatic veins of the caudal region.

Anteriorly, in the cloacal region, the caudal vein divides into two veins, the *right* and *left posterior cardinal veins*. (Figs. XI, XII, XV, XVIII, XIX, pcr, pcl.) These vessels run parallel with each other, just below and on each side of the posterior dorsal aorta. The right posterior cardinal is much smaller than the left. (See Figs. XII, XV, XVII.) Each lies internal to and in contact with that side of the corresponding mesonephros which faces toward the median line. The posterior cardinals are joined by a large number of short transverse commissural vessels (about twenty-five in all). They are not placed at regular intervals, but are more numerous in the posterior region. They vary in size, being usually about as wide as the *right* cardinal vein. The posterior cardinals receive two sets of branches: (1) the renal branches; (2) the somatic veins.

The *renal branches* (see Fig. XII), appear to arise, for the most part, on the ventral surface of the mesonephros. They collect together and form small twigs, which run across toward the median line and empty into the corresponding posterior cardinal vein. These renal veins are somewhat irregularly distributed, but traces of their original segmental arrangement are easily recognized.

The *somatic* veins have already been described in a general way. Those of the abdominal region pass dorsal to the corresponding mesonephros (receiving no branches from them), and empty into the corresponding posterior cardinal vein.

The posterior cardinals receive no veins from the intestine. In one instance only I observed a branch from the testis running upward into the right posterior cardinal vein.

Anteriorly, a short distance behind the heart, the right and left posterior cardinals unite again to form the unpaired *posterior common cardinal vein* (Fig. XVII, pcc), which passes forward on the left side, and empties into the posterior end of the sinus venosus.

The *sub-intestinal vein* (Figs. XI, XV, XVII, XVIII, sub. int.) arises from the ventral wall of the intestine toward the anterior end. It passes forward along the median ventral line of the intestinal wall, and on reaching the hepatic ligament, passes down along its posterior margin to the posterior lobe of the liver. (Fig. XI.) In some specimens it passes through the tissue of the liver for a considerable distance, but in others it runs along the surface, within the serous membrane. It passes behind the liver, and runs forward on its ventral and external aspect. It receives branches from the posterior lobe of the liver, and becomes the posterior hepatic vein (hp). As such it passes upward, parallel and near to the bile duct of the posterior lobe. It becomes very much widened, and finally empties into the posterior end of the sinus venosus, opposite the common posterior cardinal vein.

The veins of the anterior lobe of the liver converge to form the *anterior hepatic vein*, which lies on the dorsal surface of the lobe. (Figs. XI, XVII, XVIII, ha.) This vein runs forward and upward, emptying into the left side of the sinus venosus, a little behind the sinu-auricular opening.

There is also apparently a small vein running in the ligament between the anterior end of the posterior lobe, and the posterior end of the anterior lobe. The veins from the gall cyst, as will be seen, join the portal system, and will be described there.

The Portal Venous System.

The portal venous system includes the portal vein and all the vessels which flow into it.

The *anterior portal vein* (Figs. XVII, XVIII, XIX, ap) arises in the right branchial region, a little in front of the posterior end of the "club-muscle." (Fig. XIX.) It lies just below and to the right of the notochord, and receives the somatic veins from the right side in the branchial region. A few scattering venous twigs from this region also pass across into the inferior jugular vein. The anterior portal continues backward into the fold (portal septum), separating the inner and outer chambers of the right pericardial cavity, as previously described. It passes between the alimentary canal and the right pronephros, and opens into the roof of the portal heart near the anterior end. The entrance is guarded by a pair of thin membranous valves, semi-lunar in shape, one anterior and one posterior. (See Fig. XVI, ap.) Just before entering the portal heart it receives a branch which is made up of a twig from the pronephros, and (often) two or three somatic veins lying opposite and posterior to the portal heart. In one instance, I observed an anastomosis between this vein and a somatic vein emptying into the right posterior cardinal vein.

The *supra-intestinal* vein (Figs. XI, XII, XV, XVII, XVIII, XIX, supr. int.) receives the blood from the entire intestinal wall, excepting the floor in the anterior region. It runs forward just above the intestine a little to the right of the median line, within the mesentery. It lies to the right of the vagus nerve and the mesenteric arteries. In the region of the reproductive organs the supra-intestinal vein receives several *genital veins* which descend in the mesentery. These veins are formed by the plexus of small venous twigs in the special genital fold of the mesentery (Figs. XII, XVIII, gen). On reaching the pericardial region, the supra intestinal vein turns to the right side of the intestine. Here it receives the *cystic vein* (Fig. XIX, cv), which is made up of branches from the gall cyst. The supra-intestinal vein then passes through the pericardio-peritoneal foramen, beside the intestine, and below the right mesonephros. It then crosses

the roof of the outer chamber of the right pericardial cavity just below the right vagus nerve, and enters the roof of the portal heart near the posterior end. (See Fig. XVI, supr int.) The slit through which the blood enters is diagonally placed, and guarded by a pair of semi-lunar valves, like those of the anterior portal.

The *portal heart* (Figs. X, XVI, XVII. XVIII, XIX, H.) lies in the pericardial fold which forms the septum in the right pericardial cavity. It is an elongated sac (1-2 cm. in length), somewhat irregular in shape and variable in size. It stretches diagonally across the pericardial cavity, and lies nearly opposite the ventricle (cf. Fig. X). Anteriorly it receives the anterior portal vein; toward the posterior end it receives the supra-intestinal vein. Both these enter dorsally. At its posterior extremity the portal heart empties into its efferent vessel, the *common portal vein*. The opening into the common portal vein is guarded by a pair of strong semi-lunar valves (Fig. XVI, cp), which are placed laterally, and like the other valves previously described, prevent any reflux of blood during the circulation.

Johannes Müller was mistaken in his statement that no muscle fibers exist in the portal heart of Bdellostoma.* The wall is quite muscular, fully as much as that of the auricle. As in the latter, the inner surface of the wall of the portal heart is made irregular by muscular and fibrous trabeculæ, which project from the surface. The muscle fibers are *distinctly striated*, and their nuclei seem to lie on the sides of (not within) the contractile fibers.

The *common portal vein* (Figs. XVII, XVIII, XIX, cp) continues backward and inward toward the median line. It passes above the anterior lobe of the liver, to which it gives off ventrally a large branch which descends almost vertically alongside the hepatic duct of the anterior lobe. (XI, cpa). The main trunk of the common portal vein then crosses the median line to the left side and passes backward and downward alongside the hepatic duct of the posterior lobe. (Fig. XI, cpp.) About the center of the dorsal surface it enters

*Vergl. Anat. der Myxinoiden (1834). Later Müller observed the pulsations of the portal heart in living Myxine. Untersuchungen über die Eingeweide der Fische (1842).

the posterior lobe and breaks up into capillaries in the tissue of the liver.

I have observed in several cases a marked tendency for the injected carmine gelatine to escape from the blood vessels into the surrounding lymphatics, which are very numerous and extensive. These lymphatic spaces, especially the subdermal spaces in the caudal region, and the peri-branchial spaces around the gill pouches, are usually found more or less injected, although the blood vessels show no signs of overdistension. The lymphatic spaces around the vessels in the gill itself are also often filled. This condition may be interpreted as indicating that the capillary walls are unusually weak and permeable, so that the injected liquid passes through them, carrying blood corpuscles with it. That this process is not normal is shown by the absence of red blood corpuscles from these lymphatic spaces in life, and in uninjected specimens.

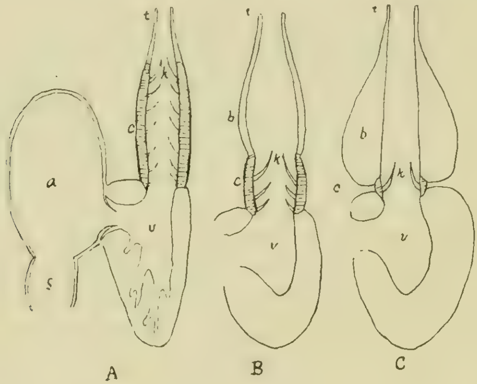
Remarks on Comparative Anatomy of Bdellostoma.

The communication of the pericardial cavity with the peritoneal cavity through the pericardo-peritoneal foramen is primitive. The heart, which is a specialized portion of the primitive sub-intestinal vessel, always develops at first in the anterior end of the general peritoneal cavity. In all adults, however, a special pericardial cavity is formed. In Petromyzon, whose pericardial sac is enclosed in a cartilaginous pocket, the separation is complete. In the larval Ammocœtes, however, there exist two larval pericardio-peritoneal foramina, one on either side. Communication between pericardial and peritoneal cavities exists also in Elasmobranchs and Ganoids, but only during embryonic life in all higher vertebrates.

Although its embryological development is not yet worked out, the sinus venosus doubtless at first receives a right and left *ductus Cuvieri*, like Petromyzon (Goette), and higher forms. The right ductus has probably been lost altogether in a manner which will be discussed later. The left ductus Cuvieri has apparently fused with the sinus venosus, and is represented by the external portion of the posterior expanded

division of the sinus, which still receives the right anterior and posterior cardinals.

In the absence of a contractile valved *conus arteriosus*, Bdellostoma and all the Cyclostomata resemble the Teleosts more than the Elasmobranchs. (See text figures A, B, C.)



A, Elasmobranch.
B, Ganoid.
C, Teleost.
s, sinus venosus.
a, auricle.
v, ventricle.
c, conus arteriosus.
b, bulbus arteriosus.
t, ventral aorta.
k, valves.
(From Boas's Zoology.)

In this respect the Bdellostoma is probably not primitive, since in the Sharks and Ganoids there is clearly a tendency to a reduction in the number of the valves and the size of the conus.*

Contrary to Müller's statement (Vergl. Anat. der Myxinoiden, pp. 180), the bulbus aortæ is *not* entirely devoid of muscular fibers. As in the arteries in general, there is a small amount of plain muscle fibers mixed with the thick layer of elastic fibers. The bulbus is evidently not contractile, however, in the ordinary sense of the word.

*It is quite possible, however, that the absence of a conus represents a condition more primitive than the Elasmobranch. No valved conus appears during the development of Petromyzon.

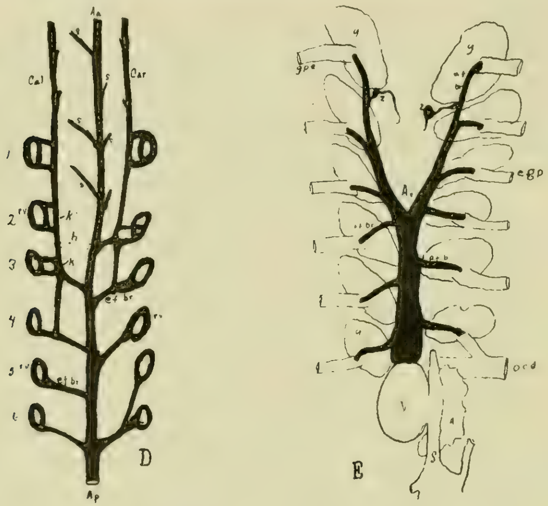
Variations from the structure of the typical ventral aorta, as previously described, are very common. As an extreme instance, I may mention a case mentioned by Müller, in which the ventral aorta, immediately after leaving the heart, divided into two branches from which all the afferent branchial arteries arise.

With respect to the "ductus Botalli," Müller noted the following in *Bdellostoma forsteri*:" "Ehe wir die Gefässe der Myxinoiden ganz verlassen, müssen wir noch einer Beobachtung gedenken, welche auf einen Entwickelungszustand des Gefäss-systems der Myxinoiden einiges Licht wirft. Ich habe nämlich bei dem grossen Myxinoid vom Cap wiederholt die Reste zweier ductus Botalli bemerkt, welche früher ohne Zweifel die *arteria branchialis* mit dem Arterien system in Verbindung setzten, jetzt aber ganz feine fadenartige Stränge bilden, deren Ursprung aus der *arteria branchialis* und Ende in Arteriensystem des Körpers aber noch hohl sind. Dieser Faden entspringt aus dem Aste der Kiemenarterie zur vordersten Kieme, in gleicher Weise auf jeder Seite. Bei seinen Ursprung ist er ansehnlich dick, conish und hohl, die Fortsetzung ist aber sehr fein, sie geht vorwärts aufwärts gegen die Carotis hin, wo diese aus den vordern Kiemenvenen entsteht, hier erweitert sich der Faden wieder, wird wieder hohl und senkt sich in die Anfang der Carotis ein. Aus diesem hohlen Ende des Fadens gehen einige feine Zweige zu den Pleuren ab. Diese Anordnung fand ich in gleicher Weise bei mehreren grossen Exemplaren von *Bdellostoma forsteri*. Ich habe sie auch bei den *Myxinen* gesehen. Diese obliterirten ductus Botalli waren offenbar früher weite Aortenbogen von dem *truncus arteriosus* des Herzens zu den Carotiden und von diesen weiter zur Aorta." (loc. cit., pp. 191.)

I have already described the same structures found in *Bdellostoma dombeyi*. In addition to the observation of Müller, I have added that a spheroidal or flattened mass of connective tissue is found attached to the "ductus" a short distance from its origin. This body is larger and more saccular in appearance in *Bdellostoma forsteri*. (See text figure E, z), and evidently may be interpreted as the rudiment of the *gill pouch* corresponding to the obliterated branchial artery. A similar ductus Botalli from the first branchial

artery is found in certain Caducibranchiata. In these cases, a "rete mirabile" persists in the course of the ductus, and represents the obliterated gill. (Balfour, Comp. Embryol. Vol II.)

Since the "ductus Botalli" is a constant feature in all specimens of *Bdellostoma* examined, its significance lies in



D, efferent branchial system of *Bdellostoma forsteri*, dorsal view.
E, heart and afferent branchial system of *Bdellostoma forsteri*, ventral view.
Ap. posterior dorsal aorta.
Aa, anterior dorsal aorta.
Car, right carotid.
Cal, left carotid.
ef. br, efferent branchial artery.
rv, ring vessel of gill passage.
S, sinus venosus.
A, auricle.
V, ventricle.
Av, ventral aorta.
afb, afferent branchial artery.
z, body on "ductus Botalli."
g, gill pouch.
gpe, external gill passage,
ocd, oesophago-cutaneous duct.

the fact that even in the 13-gilled forms, we have to do with a *reduction* rather than an *increase* in the *primitive number of gills*. The embryological development, according to Price (Some Points in the Development of a Myxinoid. Verhl. der Anat. Ges., 1896), renders this conclusion certain. A large

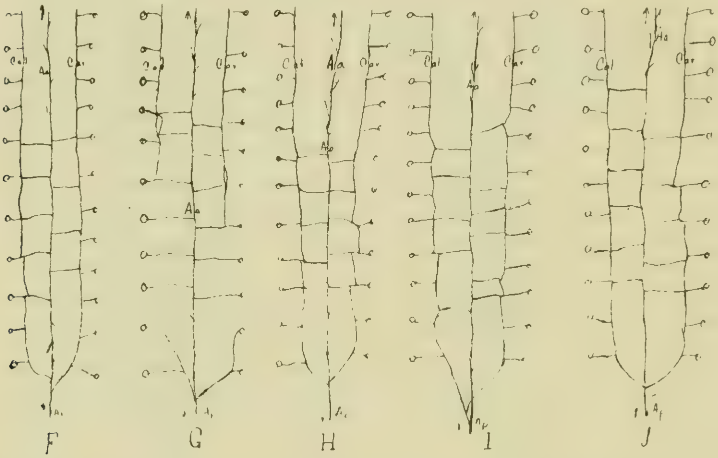
number of gill pouches (possibly thirty-five pairs) arise during the course of development. Of these, only the posterior 10–14 pairs remain to form the permanent gills of the adult.

The distribution of branchial vessels, one to each gill cleft (gill pouch), is a character in which the Myxinoids differ from all other Vertebrates. Even in Petromyzon, each afferent and efferent vessel is distributed to the *hemibranch* of *two different pouches*, the gill arteries corresponding to *gill-arches* rather than *gill clefts*. It is probable that the Myxenoid condition is not primitive, although the embryological development is not known. A probable explanation of the manner in which this unique condition has been derived from the primitive arrangement is suggested by an examination of the efferent branchial vessels and their connections in *Bdellostoma forsteri* (see text figure D.) Here we find, usually, *two efferent branchial vessels* (ef, br) arising from the ring vessel (rv) which surrounds the gill passage on the wall of the gill pouch. These efferent vessels unite with the lateral carotid vessels, and with the dorsal aorta by anastomoses. This is an interesting intermediate stage between the arrangement of the vessels in *Bdellostoma dombeyi* (see Plate III, Fig. XX), and the ordinary vertebrate type. Referring again to text figure D, suppose, for example, we take afferent vessels from gill 3. If we fuse the two vessels together (which is almost accomplished in the sixth gill, right side), or obliterate one of them, we get *one* efferent vessel for each gill, as in gills 4, 5, and 6, left side. This is the condition in *all* the gills of *Bdellostoma dombeyi*. But if we break the connection at k, gill 3, and k^1, gill 2, and at the same time connect the artery between them with the dorsal aorta by a vessel, h (dotted outline), this vessel, h, would be an *efferent branchial artery* of the *usual vertebrate type*. It would receive the blood from the posterior hemi-branch of gill 2, and the anterior hemi-branch of gill 3. I have no doubt that this very relation would be found as a variation, if a large number of specimens of *Bdellostoma forsteri* were examined.

A consideration of the extreme variability of the blood vessels in *Bdellostoma* renders this explanation all the more probable. To give a more adequate idea of the nature and extent of variation, I have made diagrams to show the rela-

tion between the efferent branchials, carotids, and dorsal aorta, as I found it, in five specimens of *Bdellostoma dombeyi*, taken entirely at random.

The variations apparently have no constant relation to the size or sex of the specimen. The number of efferent vessels, of course, varies with the number of gills.



F, G, H, I, J. Diagrams of the efferent branchial arteries and their connections (dorsal view) in Bdellostoma dombeyi. Lettering same as in plate figures (q. v.)

As a result of his studies of the blood vessels of Chlamydoselachus, Dr. Ayers (Morphology of the Carotids, Bul. Museum. Comp. Zool., Harvard. Vol. XVII, No. 5, p. 211), reaches the following conclusion: "It is likewise obvious that the carotid vessels cannot strictly be said to arise from, or constitute the remains of, any particular pair of aortic arches, but represents all that is left of the commissural trunk from the most anterior arch of the ancestral form to the most anterior arch of any existing form." Bdellostoma and the Myxinoid type would seem to indicate rather the origin of the carotid arteries from a longitudinal trunk connecting *all* the efferent branchial vessels on each side.

I have not as yet been able to work out fully the distribution and homologies of the blood vessels in the head region. This problem, on account of its difficulty and importance, is reserved for a special paper. I may mention, however, that

the extension forward of the sub-chordal dorsal aorta into the head region as the *vertebralis impar* (*vertebralis impar capitis*, of Müller; *cranial aorta*, of Ayers) is probably a primitive character. This vessel occurs in Chlamydoselachus, as well as the Cyclostomata.

Müller describes a vein in Bdellostoma forsteri which runs from the right pronephros to the posterior cardinal. Only once have I found a similar vessel in Bdellostoma dombeyi. The vein which he describes from the intestine to the common posterior cardinal is also apparently lacking in Bdellostoma dombeyi.

In Petromyzon, as in most Vertebrates, but unlike Bdellostoma, the genital veins open into the posterior cardinals instead of the supra-intestinal vein. The difference in size between the right and left posterior cardinals is only one example of the great asymmetry of the venous system which is so characteristic of Bdellostoma.

The sub-intestinal vein* is the homologue of the large ventral vein in Amphioxus, and the embryonic sub-intestinal vein of higher vertebrates. Judging from the development of Petromyzon (Goette, Entwickelungsgeschichte des Flussneunauges) and other forms, the sub-intestinal vein at first probably supplied the entire intestine, and was continued posteriorly into the caudal vein. The connection of the caudal vein with the posterior cardinals is very probably here, as elsewhere, a secondary arrangement. The reduction in the size and extent of the sub-intestinal vein is correlated with the development of the supra-intestinal vein. It is interesting to note that in Bdellostoma the sub-intestinal vein *does not break up into capillaries in the liver* to form a portal system, although it runs over the surface of, and even *through* the liver tissue. This is evidently an extremely primitive character, for the same relation is found in the early *embryonic* development of the same vessel in Petromyzon (Goette, loc. cit.), and all higher Vertebrates. According to Willey ("Amphioxus and the Ancestry of the Vertebrates") it is yet doubtful whether the sub-intestinal vein in Amphioxus forms a *true* capillary portal system, or merely passes through

*It is a remarkable fact that the presence of this vein in Bdellostoma has apparently been overlooked heretofore by all observers, including Johannes Müller.

a system of small sinuses *outside the liver proper.* In all Vertebrates above Bdellostoma (including Petromyzon), the sub-intestinal vein in the adult forms a part of the portal system.

The inferior jugular vein when median and *unpaired*, as in Petromyzon and some of the higher fishes, always empties into the sinus venosus. When *paired*, as in other fishes, it empties into the ductus Cuvieri on each side. Müller recognized that the posterior end of the right anterior cardinal represented the inferior jugular of other forms, but did not describe it as such. According to him (Vergl. Anat. der Myxinoiden, p. 209), the inferior jugular always originates in the hyoid arch and the under side of the operculums. It also commonly receives branches from the muscles of the pharynx, *venæ branchiales inferiores* and *venæ nutritiæ* of the gill arches. Its origin in Myxinoids is dorsal to the ventral aorta, but its course is ventral to it. The large "club-muscle," therefore, has a *double* venous supply. The "retractor" portion is supplied by the inferior jugular vein; the "compressor" portion by the lateral anterior cardinals (jugulars).

The anterior cardinals (or jugulars) of Bdellostoma agree in all essential respects with those in other fishes, excepting the posterior end of the right cardinal. From the probable ancestral form, as represented in Elasmobranchs (viz., symmetrical cardinals, anterior and posterior, flowing into right and left ductus Cuvieri on each side) the present arrangement in Bdellostoma may easily have arose as follows: 1. An anastomosis was formed between the right anterior cardinal and the inferior jugular, near the posterior end of the "club-muscle;" 2. An anastomosis of the posterior end of the anterior cardinal with the portal system; 3. An obliteration of the primitive anterior cardinal vessel *just behind* each of these anastomoses. Furthermore, by a union of the anterior ends of the posterior common cardinals, the blood was diverted from the *right* into the left *ductus* Cuvieri, and the right ductus disappeared entirely. The embryology of the cardinal veins, when worked out, will decide whether this is the true explanation of the present condition in Bdellostoma.

In no other fishes does the blood from the walls of the anterior body region pass into the portal system. It is said

to occur in some Testudinata and Amphibia, however. The portal system of Bdellostoma is also remarkable in being developed chiefly from the supra-intestinal vein, and in having no connection whatever with the sub-intestinal vein.

A well developed portal heart, contractile and supplied with a complete system of valves, so far as I know, occurs nowhere else among Vertebrates (excepting the closely related Myxine?). Contractile veins, however, are not uncommon.

I may sum up my conclusions in regard to the Comparative Anatomy as follows:

PRIMITIVE CHARACTERS IN THE BLOOD-VASCULAR SYSTEM OF BDELLOSTOMA.

1. Persistent pericardio-peritoneal foramen.
2. The simple tubular heart.
3. The large number (up to 14) of functional branchial vessels.
4. The origin of the carotid arteries from a lateral commissural vessel on each side connecting all the efferent branchial arteries.
5. The complete sub-chordal aorta (dorsal aorta) extending forward into the head region.
6. Segmental arrangement of the somatic and renal arteries and veins.
7. Frequent anastomosis between the posterior cardinal veins.
8. Persistent sub-intestinal vein which does not join the portal system.
9. The presence of an inferior jugular vein.
10. The contractility of the portal heart.

CHARACTERS SECONDARILY ACQUIRED.

1. The asymmetry of the venous system.
2. Distribution of branchial vessels to gill slits instead of gill arches.
3. The extension of the portal system into the territory of the right anterior cardinal vein.

4. The connection of the caudal vein with the posterior cardinals.

5. The presence of a well developed valvular portal heart.

EXPLANATION OF LETTERING USED IN FIGURES.

- *A*, auricle.
- *Al*, alimentary canal.
- *Av*, ventral aorta.
- *Aa*, anterior dorsal aorta.
- *Ap*, posterior dorsal aorta.
- *BA*, bulbus aortæ.
- *Car*, right common carotid.
- *Cal*, left common carotid.
- *H*, portal heart.
- *I*, intestine.
- *L*, liver.
- *La*, anterior lobe of the liver.
- *Lp*, posterior lobe of the liver.
- *M*, mesentery.
- *S*, sinus venosus.
- *T*, lobules of testis.
- *V*, ventricle.

- *aha*, anterior hepatic artery.
- *acl*, left anterior cardinal vein.
- *acr*, right anterior cardinal vein.
- *avv*, auriculo-ventricular valves.
- *av*, aortic valves.
- *af. br*, afferent branchial arteries.
- *ap*, anterior portal vein.
- *cv*, cystic vein.
- *cm*, "club-muscle."
- *clb*, "club-muscle" branches.
- *cap*, capillary network.
- *conv*, connecting vessel.
- *cpa*, anterior branch of the common portal.
- *cpp*, posterior branch of the common portal.
- *coel*, coeliac artery.
- *caud*, caudal vessel.
- *cp*, common portal vein.
- *d*, dermal branches.
- *dcd*, deep anterior cardinal.
- *ep*, epithelium of the gill cavity.
- *ef. br*, efferent branchial artery.
- *ext. car*, external carotid artery.
- *gen*, genital branches.
- *gb*, gall cyst.
- *gpe*, external gill passage.
- *gpi*, internal gill passage.
- *gp*, cavity of the gill pouch.
- *g*, gill pouch.
- *ha*, anterior hepatic vein.
- *hp*, posterior hepatic vein.
- *i*, inner (visceral) layer of the pericardium.
- *ic*, "intercostal" vessel.
- *int. car*, internal carotid artery.
- *jv*, inferior jugular vein.
- *lbr*, lateral branch.
- *mc*, mesocardium.
- *mnr*, right mesonephros.
- *mnl*, left mesonephros.
- *mw*, muscular wall of gill pouch.
- *my*, myotomes.
- *mes*, mesenteric arteries.
- *ntc*, notochord.
- *o*, outer (parietal) layer of the pericardium.
- *ocd*, oesophago-cutaneous duct
- *pcr*, right posterior cardinal vein.
- *pcl*, left posterior cardinal vein
- *pcc*, common posterior cardinal
- *ph*, pharyngeal branches.
- *pnr*, right pronephros.
- *pnl*, left pronephros.
- *ptc*, peritoneal cavity.
- *pcf*, pericardio-peritoneal foramen.

pcv,	pericardial cavity.	*supr. int*,	supra-intestinal vein.
pha,	posterior hepatic artery.	*sn*,	"intercostal" nerve.
rbc,	red blood corpuscles.	*sgl*,	slime glands.
r,	renal branches.	*sav*,	sinu-auricular valves.
spc,	spinal cord.	*s*,	somatic vessels.
sub. int,	sub-intestinal vein.	*vv*,	valves of portal heart.
scd,	superficial anterior cardinal.	*vg*,	vagus nerve.
		x,	"ductus Botalli,"

In figures IV, V, VI, red line indicates peritoneum; in all other figures—red, arteries; blue, veins; green, portal vessels.

EXPLANATION OF PLATES.

Plate I includes Figures I–IX.

Plate II includes Figures X–XVI.

Plate III includes Figures XVII–XX.

FIGURE I.—Heart of *Bdellostoma dombeyi* (×1). Dorsal view.

A, auricle. V, ventricle. S, sinus venosus. BA, bulbus aortæ. jv, inferior jugular vein. acl, left anterior cardinal. pcc, posterior common cardinal. ha, anterior hepatic vein. hp, posterior hepatic vein.

FIGURE II.—Heart of *Bdellostoma dombeyi* (×1). Ventral view. Lettering same as in Fig. I.

FIGURE III.—Heart of *Bdellostoma dombeyi* (×2). Showing a dorsal view of the ventral half of the auricle and ventricle, the dorsal half having been removed by a horizontal section.

sav, sinu-auricular valves. avv, auriculo-ventricular valves. av, aorta valves. Otherwise as in Fig. I.

FIGURE IV.—Diagram of cross section passing through the mid-abdominal region of *Bdellostoma*.

M, mesentery. A, alimentary canal. ptc, peritoneal cavity.

FIGURE V.—Diagram of cross section passing through the posterior lobe of the liver in *Bdellostoma*.

L, liver.

FIGURE VI.—Diagram of cross section passing through the ventricle and anterior lobe of the liver. Showing the relation of the pericardial cavity to the general peritoneal cavity.

pcf, pericardio-peritoneal foramen. pcv, pericardial cavity. o, outer or parietal layer of the pericardium. i, inner, or visceral pericardial layer. me, mesocardium. V, ventricle. Dotted line, pericardium.

FIGURE VII.—Testis of *Bdellostoma dombeyi* (×2), showing the arterial supply. The genital fold lies on the right side of the mesentery.

wS, mesenteric artery. qs, genital branches. T, lobules of testis. Ap, posterior dorsal aorta.

FIGURES VIII AND XIV.—Highly magnified portions of the smallest branches of a gill leaflet (×450).

cap, capillary wall. ep, epithelium lining gill cavity. rbc, red blood corpusles. con, connective tissue.

FIGURE IX.—Cross section of an injected gill pouch of *Bdellostoma* (×8). Taken perpendicular to the gill axis, about at the center.

Camera lucida outline.

mw, muscular wall of gill pouch. gp, cavity of gill, into which gill leaflets project.

FIGURE X.—Branchial region of *Bdellostoma dombeyi* (×1½). Ventral view. Body wall opened by a median longitudinal incision, and the lateral flaps folded back. Anterior lobe of the liver removed to expose heart. Arteries colored red. Veins blue.

Av, ventral aorta. af. br, afferent branchial arteries. x, on last afferent branchial artery indicates position of "ductus Botalli." ic, "intercostals" (arteries red, veins blue). S, Sinus venosus. jv, inferior jugular vein. acl, left anterior cardinal vein. supr. int, supra-intestinal vein. A, auricle. V, Ventricle. H, portal heart. Lp, posterior lobe of liver. gb, gall bladder. mnr, mnl, right and left mesonephros. pnr, pnl, right and left pronephros. pcf, pericardio-peritoneal foramen (dotted outline). sgl, slime glands. ocd, oesophago-cutaneous duct. cm, "club-muscle." gpe, spe, external gill passages.

FIGURE XI.—Lateral view of the viscera of *Bdellostoma dombeyi* left side, including ventral view of the left half of the body wall, which has been laid back (×1).

cpa, anterior branch of common portal vein. cpp, posterior branch of common portal vein. Jv, inferior jugular vein. acl, left anterior cardinal. ha, hp, anterior and posterior hepatic veins. cpa, cpp, anterior and posterior branches of common portal vein. ocl, left posterior cardinal. supr. int, supra-intestinal vein. sub. int, sub-intestinal vein. La, Lp, anterior and posterior lobes of the liver. pnl, left pronephros. mnl, left mesonephros. ic, "intercostal" vessels. Otherwise as previously.

FIGURE XII.—Mid abdominal region of *Bdellostoma dombeyi*, showing ventral view of the left side of the body wall, and a lateral view of the intestine and mesentery. The latter have been laid over upon the right side of the body wall, and the mesentery stretched out (×2).

r, renal branches. s, somatic branches (red, arteries; blue, veins). pcl, pcr, posterior cardinal veins, left and right. mes, mesenteric arteries. vg, vagus nerve. sn, "intercostal" nerve. Otherwise as previously.

FIGURE XIII.—Diagram of one half of a section through the gill pouch of *Bdellostoma*, parallel with the axis of the gill. Afferent vessels red. Efferent vessels blue.

af. br, afferent branchial vessel. ef. br, efferent branchial. cap, capillary network.

FIGURE XIV.—See Fig. VIII.

FIGURE XV.—Diagram of a cross section through the body of *Bdellostoma*, just behind the liver.

ntc, notochord. spc, spinal cord. s, somatic branches. ic, "intercostals." d, dermal branches. my, myotomes. Otherwise as previously.

FIGURE XVI.—A ventral view of the dorsal wall of the portal heart of *Bdellostoma dombeyi*, the ventral half having been cut away. (×2.)

ap, anterior portal vein. supr. int, supra-intestinal vein. cp, common portal vein. vv, valves.

FIGURE XVII.—Diagram of the venous system of *Bdellostoma*, dorsal view (approximately natural size). Portal system, green; general system blue. On the right side, the renal branches of the posterior cardinal are omitted. On the left side, the somatic branches are omitted.

acr, acl, right and left anterior cardinals (or jugulars). dcd, scd, deep and superficial branches of anterior cardinals. s, somatic veins. ph, pharyngeal branches. clb, "club-muscle" branches. jv, inferior jugular vein. S, sinus venosus. pnl, pnr, left and right pronephros. pcc, posterior common cardinal. pcr, pcl, right and left posterior cardinals. ha, hp, anterior and posterior hepatic veins. caud, caudal vein. ap, anterior portal vein. cp, common portal vein. gb, gall bladder. sub. int, sub-intestinal vein. gen, genital veins.

FIGURE XVIII.—Diagram of entire circulatory system in *Bdellostoma* lateral view (approximately natural size). Arterial system, red; general venous system, blue; portal system, green.

Lettering same as Figs. XVII and XX.

FIGURE XIX.—Lateral view of the viscera of the pharyngeal and cardiac regions, including ventral view of the right side of the body wall (×1½). In this figure the viscera have been laid over upon the left side, in order to show the relation of the blood vessels to the body wall. As a result, the somatic branches of the anterior portal and dorsal aorta in the branchial region are stretched somewhat beyond their normal length.

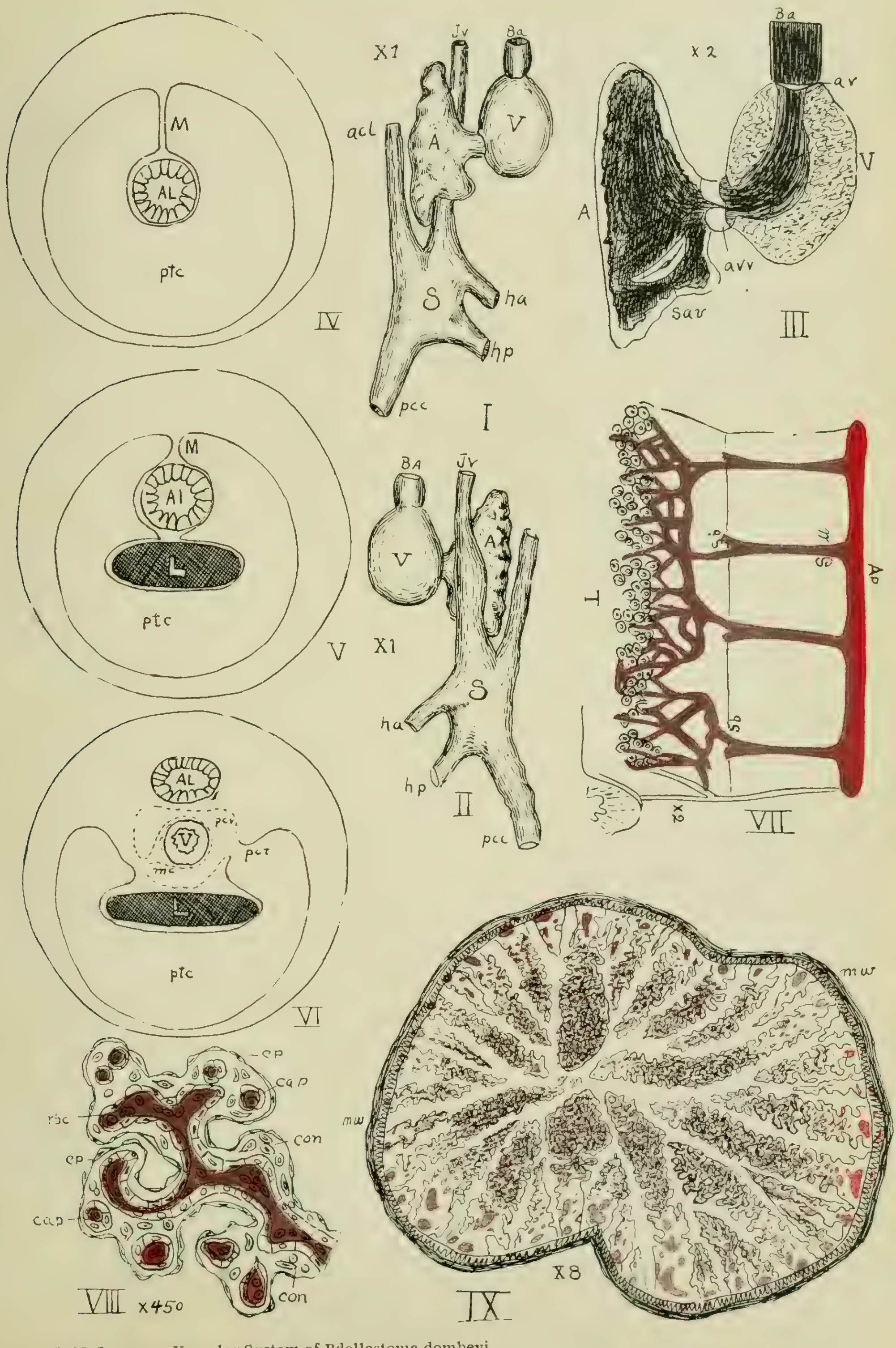
Aa, anterior dorsal aorta. Ap, posterior dorsal aorta. Car, right common carotid. pb, pharyngeal branches. ap, anterior portal vein. ic, intercostals. supr. int, supra-intestinal vein. cv, cystic vein. sub. int, sub-intestinal vein. pcr, right posterior cardinal. ef. br, efferent branchial vessels. clb, "club-muscle" branches.

Otherwise as previously.

FIGURE XX.—Diagram of the arterial system of *Bdellostoma dombeyi* dorsal view (approximately natural size). The afferent branchial system is omitted. Of the branches of the posterior dorsal aorta, on the right side, the renal branches are omitted. The genital branches should be represented on the right side.

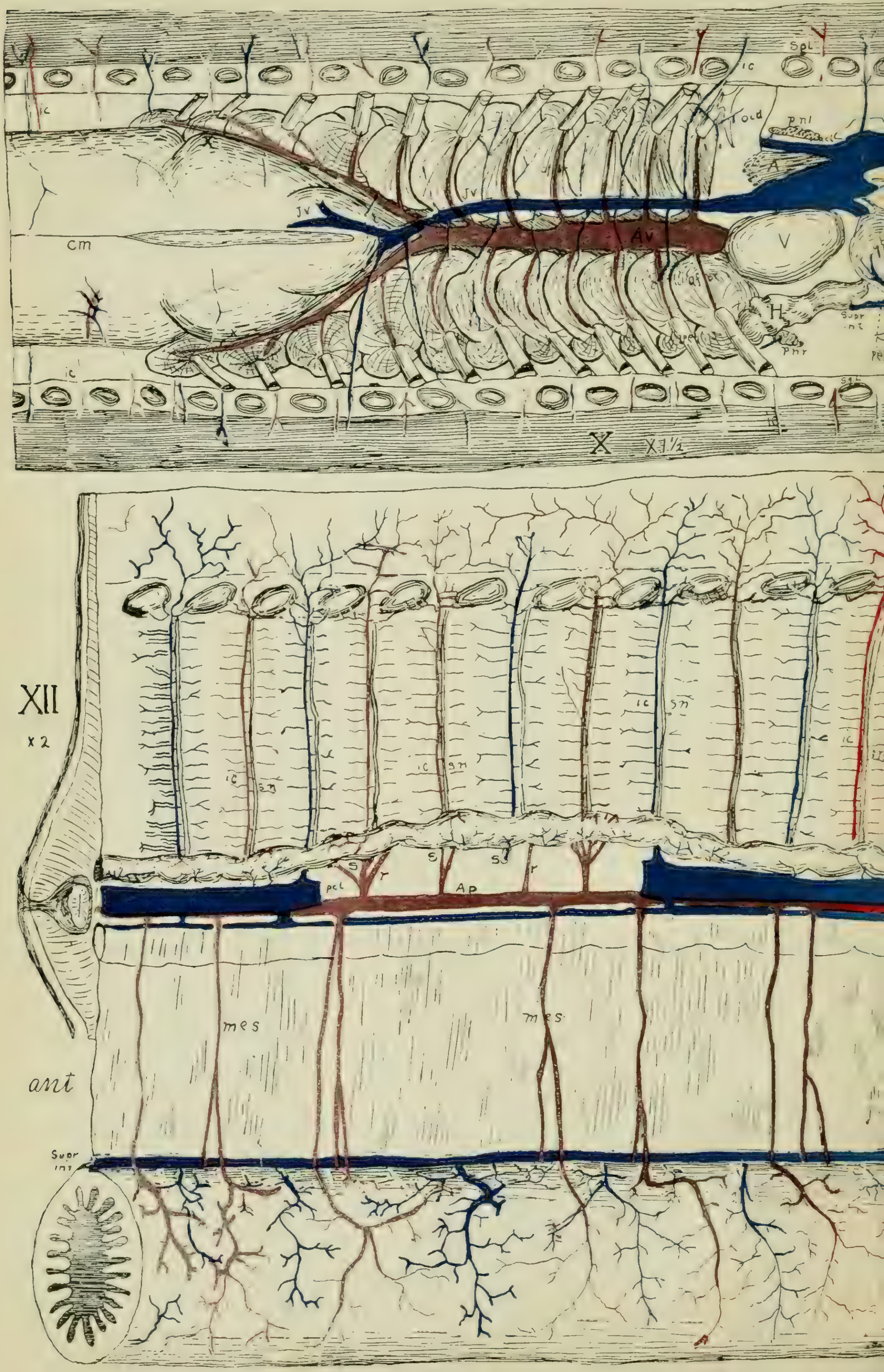
V, vertebralis impar. lbr, lateral branch. ext. car, int. car, external and internal carotid arteries. s, somatic arteries. Car, Cal, right and left common carotid arteries. ef. br, efferent branchials. con. v. connecting vessels. coel, coeliac artery. caud, caudal artery. ren, renal branches. mes, mesenteric arteries.

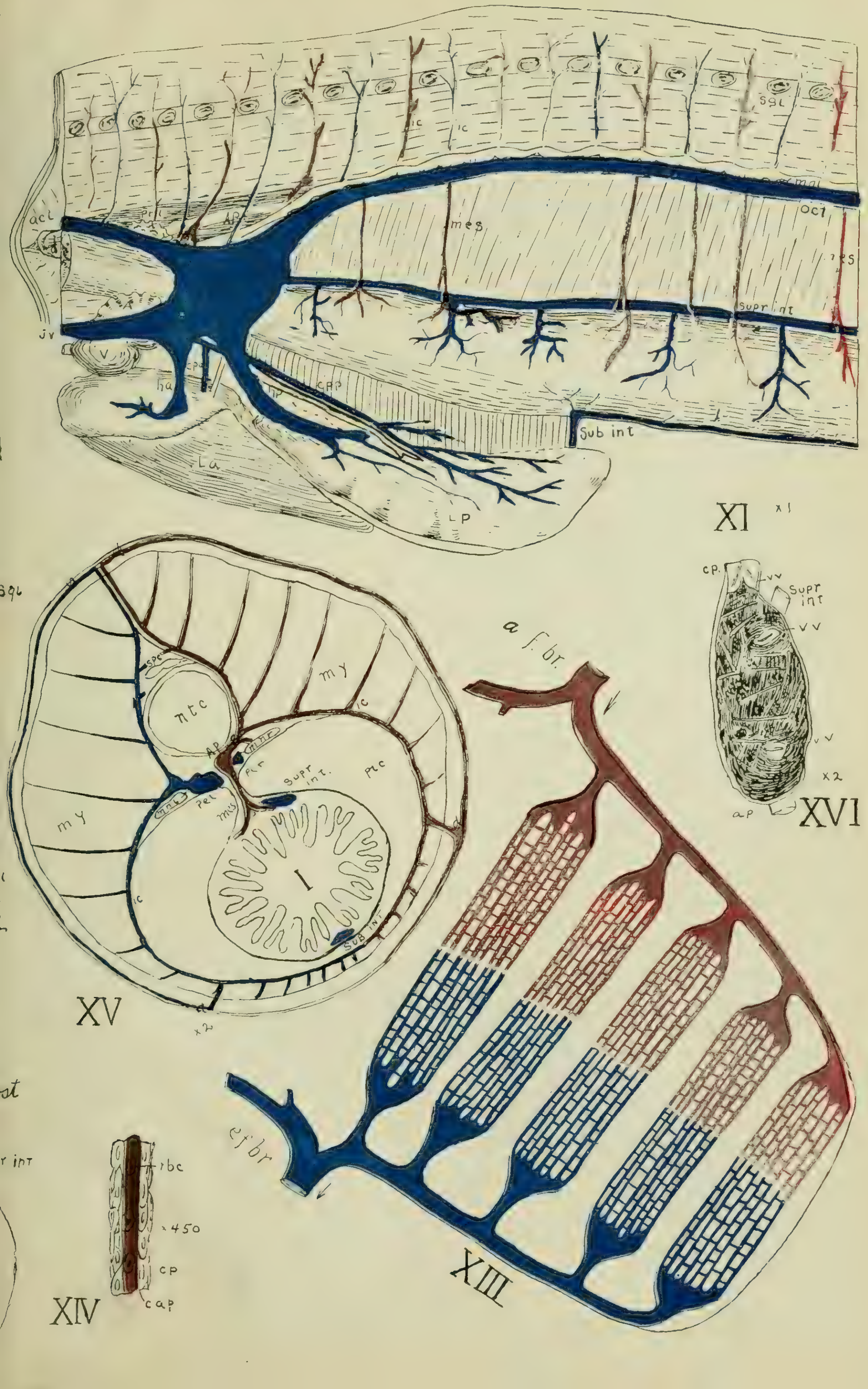
CONTENTS



C. M. JACKSON, Vascular System of Bdellostoma dombeyi.

Vol. XX. No. 1. Art. 2

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VOL. XX. NO. 1. ART. 2.

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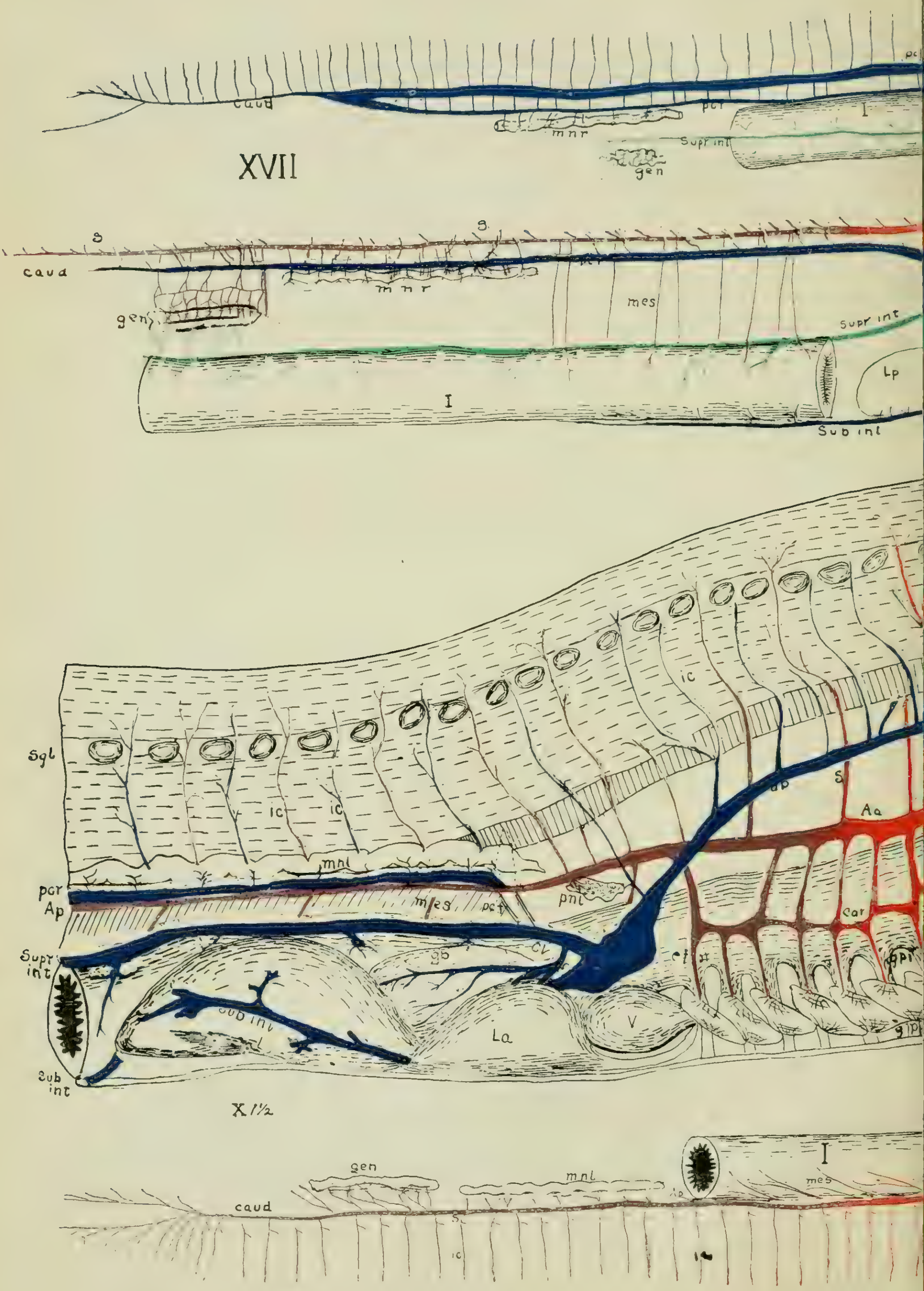

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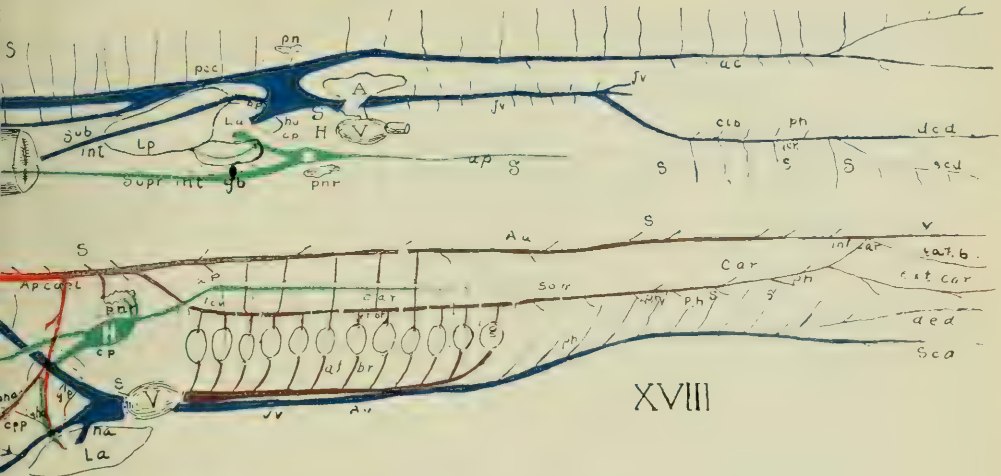
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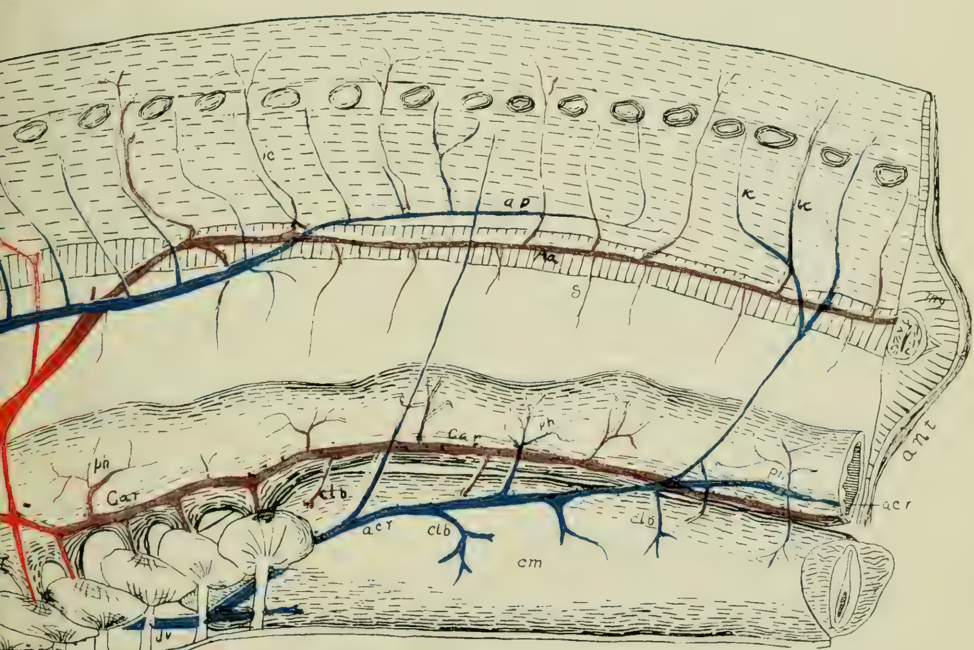
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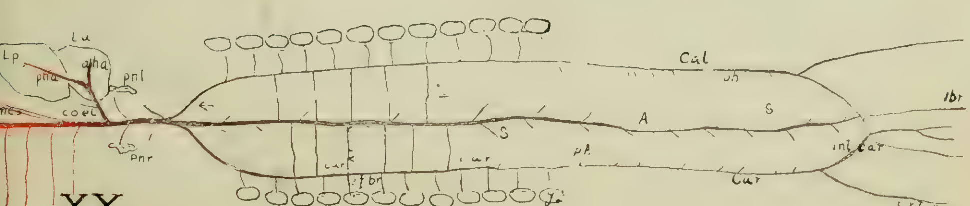
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XX

ARTICLE III.—THE GEOLOGY OF CINCINNATI.

By J. M. Nickles.

1. TOPOGRAPHY.

The name chosen for the hamlet, settled in 1788, which has become the city of Cincinnati, suggests the reason for its location — Losantiville, L [icking] + os, mouth, + anti, opposite, + ville — the village opposite the mouth of the Licking. The comparatively level tract of land, safely above the flood waters of the Ohio, rendered easy the growth from hamlet to city. Opposite the mouth of the Licking, it stood at the gateway to the northern part of the fertile blue-grass region of Kentucky, at a time when river navigation was the best available mode of transportation. An equally fertile region lay to the north, to which the broad valley of the Millcreek furnished a natural outlet when the locomotive replaced the canoe and flatboat.

This level tract, roughly circular in outline, of an average diameter of three miles, is bounded on three sides by a belt of hills, so-called. On the south the Ohio River separates it from a similar, somewhat smaller, tract lying to the southeast, which is also bordered on three sides by a belt of hills. The two tracts together form a quadrangular area, extending northwest and southeast. The area is really a somewhat basin-shaped depression in a generally rolling country. The so-called hills are the escarpments of the higher land fringing upon the basin. The Kentucky part of the basin is intersected by the Licking River traversing it from the south, dividing it into two parts, now occupied by the cities of Newport and Covington.

Some of the peculiarities of the topography of Cincinnati and vicinity early attracted attention. It was observed that the valley of the Little Miami River for several miles above its confluence with the Ohio is wider than that of the Ohio from this point down; for many miles below the mouth of the Millcreek, the valley of the Ohio is very narrow, scarcely more than a trough; the valley of the Licking is quite wide for several miles up from its mouth; the valley of the Mill-

creek, extending north for several miles, then northeast and again north, seems altogether too wide for the insignificant stream now flowing through it; from the valley of the Little Miami, between Red Bank and Plainville, a broad belt of depressed land extends northwestwardly until it enters the Millcreek valley, near St. Bernard or Ludlow Grove.

The second geological survey of Ohio, 1869–1875, began the work of accumulating the data to explain this topography. Attention was called to the broad valley of the Millcreek extending from Hamilton to Clifton, there dividing, the westerly branch still occupied by the Millcreek, the other extending east and southeast to the Little Miami valley, and it was thought that the Big Miami may have taken this course to reach the Ohio.* The depth to the solid rock in the Millcreek valley as shown by a well in Cumminsville,† 151 feet below the surface, or 60 feet below low-water mark of the Ohio River is noted, and its bearing upon elevational movements commented upon.

The first connected attempt to explain the peculiarities of Cincinnati's topography was a paper by Prof. Joseph F. James.‡ He considered that a barrier extended across the Ohio from the Kentucky shore to the south end of the range of hills west of the Millcreek, evidence of the barrier being found in the beds exposed in the bank of the Ohio near Ludlow and in McCullum's Riffle, a conspicuous bar in low water a few miles below the city; that the Ohio divided into two branches, one flowing northwest from the Little Miami valley between Red Bank and Plainville, the other south of and around the "Cincinnati Island," the higher land now occupied by the suburbs, Walnut Hills, Avondale, and Clifton, the two branches uniting near Ludlow Grove, thence together flowing to Hamilton, thence southwest through the valley of the Big Miami; the blocking of this northward channel in glacial times compelled the Ohio to cut across the barrier at Sedamsville.

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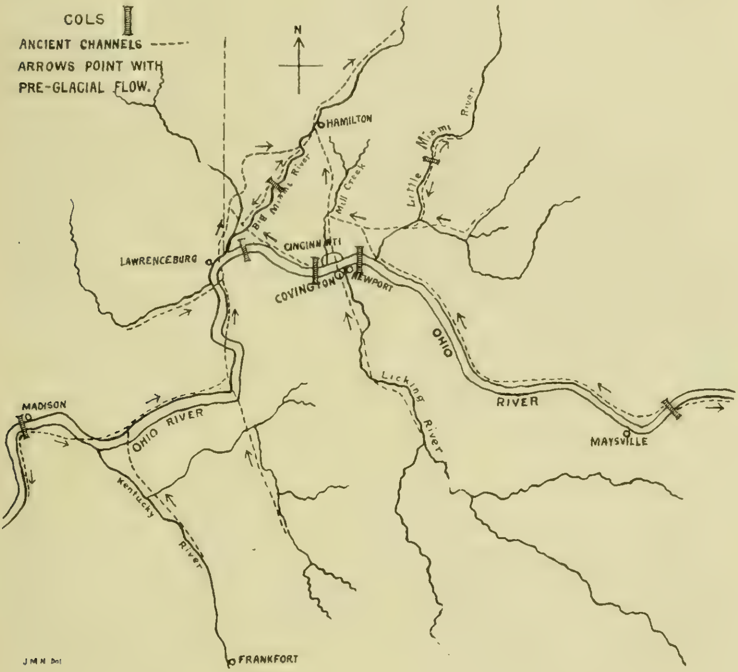
*Orton, Edward. Geol. Ohio, I, p. 420.

†Ibid., p. 433.

‡The Geology of Cincinnati. Jour. Cincinnati Soc. Nat. Hist., IX, 1886, pp. 20–31, 136–141.

Within the past few years the researches of glacialists have shown that the present drainage system of the northern half of the Ohio drainage basin is very different from what it was before the advent of the Ice Age. The earlier drainage was



shaped by the sequence of geological events in paleozoic ages. This natural drainage, so to speak, was reformed by the advance of the ice sheet from the north, carrying with it a vast mass of debris from the lands corroded by it. The ice sheet and its debris, damming up ancient channels, backed the rivers up into lakes until the latter, breaking over the lower parts or cols of the bounding ridges, fashioned for the rivers new channels. The pre-glacial drainage of southwestern Ohio has been specially investigated by Mr. Gerard Fowke.* He considers that a col extended from the high-

*Bull. Sci. Lab. Denison Univ., XI, 1899, pp. 1–10; Ohio State Acad. Sci., Special Papers, No. 3. 1900, pp. 68–75.

land east of Newport and Bellevue, Kentucky, north to East Walnut Hills, by which the waters of Old Limestone, which has furnished part of the course of the modern Ohio, were deflected north through the lower part of the valley of the Little Miami, which explains the great width of that valley. At Red Bank this ancient stream turned northwest and through the valley of the Millcreek found its way to Hamilton, Ohio, and thence to the great pre-glacial river, which has been named the Great Kanawha. At Hamilton this river was joined by the Kentucky River which flowed northeastward from its present point of confluence with the Ohio through what is now part of the Ohio's course and then northwardly and eastwardly. The Licking River, flowing northwardly through the lower part of the Millcreek valley, joined Old Limestone at Ludlow Grove. Among the changes made during or at the close of the Ice Age was the breaking down of the cols at East Walnut Hills and Sedamsville, thus giving the Ohio its present course.

2. GEOLOGY.

a. Historical.

At the time of its first settlement, the slopes of the "hills" about the city were clad in green and generally wooded. The ravines here and there laid bare the strata which form the framework of the hills. As the settlement grew quarries were opened in the slopes. Thus the region surrounding Cincinnati early became noted as affording very fine exposures of Lower Silurian strata, which yielded a very large number in great variety of finely preserved fossils.

In the year 1836 a geological survey of the State of Ohio was organized, but after two annual reports its work was brought to an untimely end by the financial troubles of 1837. The southwestern part of the State was entrusted to Dr. John Locke. In the second annual report* he gave a brief account of the "Blue Limestone," as the formation in the southwestern corner of Ohio was called, and the overlying "Cliff Limestone." Plate 2, facing p. 210, gives a section

* Second Ann. Rep. Geol. Surv. State of Ohio, Columbus, 1838, pp. 205-211.

from "Keys's Hill" across the Ohio River to "Botany Hill" in Kentucky. It is interesting to note that the main divisions of the Cincinnati strata are well indicated. The Blue Limestone was considered to have a thickness of at least 1,coo feet. The general arrangement of the strata of Ohio was fairly well understood, and the Cincinnati uplift as the axis upon whose slopes later formations were successively laid down was well made out.

As early as 1829 the Blue Limestone was correlated by Lardner Vanuxem* with the rocks occurring at Trenton Falls, New York, from their fossil contents. This determination was generally accepted for many years.

In the following decade the magnificent work of the New York Geological Survey, by making known and naming the successive Paleozoic formations of the State of New York, laid the groundwork for American geological science. Two questions the survey left unsettled; one produced the celebrated Taconic controversy, the other was the real meaning and scope of the term Hudson River group. Dr. W. W. Mather,† in charge of the First Geological District, proposed the name Hudson River slate group, which he afterward‡ amended to Hudson River group, for the lowest rocks in his district, exposed along the Hudson River. The rocks were generally unfossiliferous, and more or less altered after their deposition. The term, while accepted by the Geological Board of the State, seems not to have received entire approval or been clearly understood. Emmons§ continued to use the term Lorraine Shales for a formation, finely shown in the gorges of Jefferson County, New York, occupying supposedly the same geological horizon.

Gradually doubt arose as to Vanuxem's correlation of the Blue Limestone with the Trenton of New York. Prof. James Hall,|| in 1842, considered a green shale occurring at Newport, Kentucky, equivalent to the Utica shale of New York, and the rock below it, seen only during low water in

*Amer. Jour. Sci., XVI, 1829, p. 256.

† Fourth Ann. Rep. Geol. Survey New York, 1840, p. 212.

‡ Geol. New York, Geol. First Geol. District, 1843, p. 367.

§ Geol. New York, Part II, Second Geol. District, 1842, p. 119.

|| Amer. Jour. Sci., XLII, 1842, p. 61.

the Ohio River, as probably the equivalent of the Trenton. This early correct determination seems to have been lost sight of or disbelieved. A year later Prof. Hall* referred the main mass of strata occurring at Cincinnati to the Hudson River group. Some years later, 1862, Prof. Hall,† influenced by the studies of Sir William Logan, of the Canadian Geological survey, concluded that the strata in the valley of the Hudson referred to the Hudson River group were older geologically than those referred to the same group farther west in New York and in the Mississippi valley and proposed to drop the term. But in 1877‡ he concluded that he had been in error in dropping the term.

In 1865 Meek and Worthen,§ then at work upon the geology of Illinois, influenced by Hall's discarding the term Hudson River group and the uncertainty prevailing as to just what this term stood for, proposed the term "Cincinnati group" for the blue limestone strata of Cincinnati and vicinity and their equivalents elsewhere.

The second geological survey of Ohio began in 1869 a thorough examination of the geological structure of the State. The term "Cincinnati group" was adopted for the "Blue Limestone series" of the first survey. Partly for the reasons given by Meek and Worthen, but more especially because he considered that the blue limestone formed a homogeneous and indivisible whole in which there was a hopeless and inextricable confusion of Hudson and Trenton species, Dr. J. S. Newberry,‖ the chief of the survey, felt constrained to adopt their name. But as to this intermingling of Hudson and Trenton fossils, Dr. Newberry was mistaken; this supposed intermingling is due to the faulty identification of fossils incident to a time when paleontological science had not reached its present refinement and exactness.

This conclusion of the geological survey seems not to have been acceptable in all quarters. While Mr. S. A. Miller at

* Trans. Amer. Assoc. Geol. and Nat., 1843, pp. 267-293.

† Rep. Geol. Surv. Wisconsin, I, 1862, p. 47 (foot note) and p. 443.

‡ Note upon the history and value of the term Hudson River group in American geological nomenclature. Proc. Amer. Assoc. Adv. Sci., XXVI, 1877, pp. 259-265.

§ Proc. Acad. Nat. Sci., Philadelphia, 1865, p. 155, and Geol. Illinois, I, 1866, p. 136.

‖ Geol. Surv. Ohio, I, 1873, p. 117.

first* seems to have accepted the name, he later** calls it a synonym for the Hudson River group. In 1879 a committee of ten of the Cincinnati Society of Natural History, with Mr. Miller as chairman, submitted to that body a report† in which it was held that the strata in the river bank in the First Ward of Cincinnati (Fulton) and those in Taylor's Creek, east of Newport, containing *Triarthrus becki* are to be considered of Utica age; all strata above these indicate the Hudson River group of New York.

This summary rejection of the name Cincinnati group did not have the indorsement of all the Cincinnati geologists; Mr. U. P. James†† objected to thus summarily disposing of a valid and well-established name. As pointed out by Mr. Joseph F. James,‡ some of the members of the committee continued to use the term "Cincinnati group."

At a later date, 1888, Dr. Orton,‡‡ then State Geologist, proposed to discontinue the use of the term Cincinnati group. The three hundred feet of shale, disclosed by drilling at Findlay, Ohio, as overlying the Trenton, which he identified as the equivalent of the Utica shale of New York, led him to adopt the term Hudson River group for the shales overlying these three hundred feet of Utica shales.

In an admirable review of the Hudson River question in the light of his own investigations, Mr. Charles D. Walcott§ favored retaining the term Hudson (dropping the "River") for the series of strata between the Trenton limestone and the superjacent Upper Silurian rocks, Hudson being made the name of the terrane to include the Hudson River shales and grits, Utica shales, Frankfort shales, Lorraine shale and sandstone, Salmon River sandstone and shale, Cincinnati shale and limestone, Nashville shale, and Maquoketa shale.

The question of the name may now be considered to have been practically quieted. Winchell and Ulrich|| in their cor-

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*Cincinnati Quar. Jour. Sci., I, 1874, pp. 63-4.

**Jour. Cincinnati Soc. Nat. Hist., IV, 1881, p. 268.

†Ibid., I, 1879, pp. 193-4.

††The Paleontologist, No. 4, 1879, pp. 27, 28.

‡Jour. Cincinnati Soc. Nat. Hist., XIV, 1891, p, 98.

‡‡Geol. Surv. Ohio, VI, 1888, p. 9.

§Bull. Geol. Soc. America, I, 1890, pp. 335-356.

||Geol. Minnesota, III, Part II, 1897, p. ci.

relation of Lower Silurian strata use the title "The Hudson River or Cincinnati Period," but express their preference for the second term, the other having been placed first because used in previous volumes issued by the Minnesota survey. Clarke and Schuchert,* in giving a revised nomenclature of the New York series of geological formations, use the term Cincinnatian — with the divisions Utica, Lorraine and Richmond (Ohio and Indiana)— omitting the term Hudson River altogether. Rudolf Ruedeman† has shown by an exhaustive study of the Hudson River beds near Albany, New York, that a fault, not hitherto detected, separates the strata of the Hudson River valley from those of the Mohawk valley, and that the fauna of the Hudson River beds, mainly graptolites, proves to belong to a terrane low in the Trenton, hence the name Hudson River is a misnomer

Subdivisions.

1. River Quarry Beds — (Point Pleasant Beds.)

The Cincinnati anticline, or as Prof. Orton has since wisely renamed it, the Cincinnati uplift, is exhaustively treated by Dr. J. S. Newberry in volume I, pp. 93–111, of the Reports of the Ohio Geological Survey, to which the reader is referred for full particulars.

In the division of work of the second geological survey of Ohio Prof. Edward Orton was assigned the geology of the southwestern part of the State. In his report‡ he divides the Cincinnati group into the Point Pleasant beds, exposed in the north bank of the Ohio River in Clermont County, about twenty-five miles east of Cincinnati, to which he assigned a thickness of fifty feet; the Cincinnati beds proper, extending from low-water mark of the Ohio River to the highest stratum found in the Cincinnati hills, comprising 450 feet; and the Lebanon division, embracing about 300 feet of strata, lying between the highest stratum of the Cincinnati hills and the lowermost beds of unmistakable Upper Silurian age. The Cincinnati beds proper he divided into the river

* Science, n. s., X, 1899, pp. 874–878.
† Bull. New York State Mus., VIII, No. 42, 1900, pp. 564–568.
‡ Geol. Surv. Ohio, I, 1873, pp. 365–449.

quarry beds, fifty feet thick; the middle or Eden shales, 250 feet thick; and the Hill quarry beds, 150 feet thick.

This division was criticised by Mr. S. A. Miller,* who could not see that the Point Pleasant beds were any different from Cincinnati beds, though probably somewhat lower, and that the divisions of the Cincinnati beds proper were useless, and with no facts to warrant any such division. The committee of the Cincinnati Society of Natural History on nomenclature** reported that the Trenton is not exposed at Cincinnati, nor at any point west of the city, "but we think it may be represented in the banks of the Ohio River a few miles east of the city."

Thus the age of the Point Pleasant beds proved a matter of dispute. Mr. W. M. Linney,† of the Kentucky Geological Survey, thought the Trenton included "doubtless, the building stones quarried at Point Pleasant, on the Ohio River above Cincinnati." In a paper on the correlation of the Lower Silurian horizons, Mr. E. O. Ulrich†† seems to have regarded the Point Pleasant beds as of the same age as the strata outcropping in the river bank in West Covington, which he includes in his "Beds XI;" earlier in the same paper‡ these beds are referred to "Beds X" which are exposed at Lexington, Kentucky. Throughout this paper, which was left unfinished, the author studiously avoids indicating the age of the various beds, no doubt intending to give this in the later discussion.

In Volume VI of the Reports of the Ohio Geological Survey, dealing mainly with petroleum and natural gas, and the geological facts brought to light by the drill, the Point Pleasant beds are recognized for the first time by the survey as Trenton.§ The equivalent strata|| at Cincinnati were considered to be 300 feet below the surface. How such a dip in twenty odd miles is made to agree with the almost horizontal

*Cincinnati Enquirer, August 7, 1873.

**Jour. Cin. Soc. Nat. Hist., I, 1879, pp. 193-4;

†Notes on the Rocks of Central Kentucky. Geol. Surv. Kentucky, J. R. Proctor, Director, 1882, p. 6.

††Amer. Geologist, I, 1888, p. 307.

‡Ibid., p. 181.

§Geol. Surv. Ohio, VI, 1888, p. 5.

||Ibid., p. 6.

character of the strata of the Cincinnati uplift as previously worked out by Prof. Orton* is not explained.

In 1890 Prof. Joseph F. James studied the Point Pleasant beds and gave a detailed columnar section.** He reached the conclusion that the rocks in the river bank from West Covington to Ludlow are identical with the Point Pleasant beds, in which conclusion he was correct; and that neither belongs to the Trenton, in which he was incorrect, as these strata are unquestionably of Trenton age. In 1897 Winchell and Ulrich, in their correlation of Silurian horizons,† referred to the West Covington river beds as belonging to the Trenton group.

II. Eden Shales — (Utica Group.)

The earliest identification of Utica at Cincinnati was by Prof. James Hall in 1842 (see *ante* p. 53). The Committee on Geological Nomenclature of the Cincinnati Society of Natural History (see *ante* p. 55) also considered these strata, at least the lower part of them, as Utica. Later these strata seem to have given trouble. Ulrich in his paper on the correlation of the Lower Silurian Horizons‡ says: "Several feet of shales that are *supposed* to represent the portion of the section immediately below that mentioned in the preceding paragraph [the West Covington or Ludlow strata] are exposed under the bank of the river in the First Ward of Cincinnati." In reality these shales overlie the Trenton rocks of West Covington. This error has caused some of the fossils which properly belong in column XIb to be placed in column XIa§. In this same paper Ulrich|| identifies his "Beds XIb," to which he gives a thickness of 225 feet, with the black shales 300 feet thick, immediately overlying the Trenton in the Findlay wells, which he agreed with Prof. Orton in correlating with the Utica shale of New York. There can be no question as to the correctness of this identification.

* Geol. Ohio, I, 1873, p. 412.

** Jour. Cincinnati Soc. Nat. Hist., XIV, 1891, pp. 93-104.

† Geol. Minnesota, III. Part II, 1897, p. xcviii.

‡ American Geologist, I, 1888, p. 309.

§ Amer. Geologist, I, 1888, pp. 183-190. See also p. 312.

|| Ibid., p. 315.

In Volume VI of the Reports of the Geological Survey of Ohio, Prof. Orton* shows that the black Utica slate or shale, 300 feet thick under cover at Findlay, gradually thins toward the south and is finally lost by overlap of the Hudson River shale, and considers, that if any part of the series exposed at Cincinnati and vicinity belongs to the Utica, it is the fifty to 100 feet of greenish blue shale overlying the Point Pleasant or Trenton limestone, but thinks that, on the whole, the evidence is against their having been formed contemporaneously with the black Utica shale of northern Ohio.

III. Hill Quarry Beds — (Lorraine Group.)

To that division of the Cincinnati beds proper, that overlies the Eden or middle shales, Prof. Orton gave the name Hill Quarry beds with a thickness of 150 feet. The layer at the top of the highest hills in the city of Cincinnati, which contains the large *Orthis* (*Platystrophia*) *lynx*, and which was traced into adjoining counties on the east and north, was considered to mark the boundary between this division and the next succeeding, to which he gave the name Lebanon beds.

The name Lorraine shales was given by Ebenezer Emmons† to a series of shales finely exposed in the gorges of Lorraine and Rodman in Jefferson County, New York, overlying the Utica slate, and consisting of thin beds of gray sandstone, alternating with fine argillaceous slates of a greenish color, even bedded, and in the upper part highly fossiliferous. He did not correlate it with the Hudson River group.

No attempt was made to apply the name to strata in the Mississippi valley, until it became quite evident that the term Hudson River group was a misnomer. In their correlation of strata Winchell and Ulrich‡ propose to use the name Lorraine group for the 200 feet of strata at Cincinnati overlying the shale beds which they refer to the Utica.§ The term has also been used by Mr. Charles Schuchert in his "Synopsis of American Fossil Brachiopoda,|| but he has made it include the strata to which the term Richmond group is now applied.

*Geol. Ohio, VI, 1888, p. 8.

†Geol. New York, Part II, Survey of the Second Geol. District, 1842, p. 119.

‡Geol. Minnesota. III, Part II. 1897, p. cii.

§Ibid., p. cii.

|| Bull. U. S. Geol. Survey, No. 87, 1897.

IV. Lebanon Beds — (Richmond Group.)

The upper division of the Cincinnati series was named by Prof. Orton the Lebanon beds, with a thickness of nearly 300 feet. For this name Winchell and Ulrich* have substituted the name Richmond group, from Richmond, Indiana, where this division is finely exposed, holding that the name Lebanon is objectionable, as it was previously applied by Safford to Tennessee rocks belonging to the Trenton. Another, perhaps more valid objection, is the fact that all the strata in the immediate vicinity of Lebanon, Ohio, belong to the Lorraine group. The Richmond is not present in the New York system, unless a sandstone formation overlying the Lorraine shales represents it.

b. Stratigraphy.

THE TRENTON PERIOD AT CINCINNATI.

Point Pleasant Beds.

The principal exposures of these beds in the vicinity of Cincinnati are the outcrop in the south bank of the Ohio River, extending from West Covington one mile west to Ludlow, which presents the most satisfactory exposure for study; an outcrop at the mouth of the Licking River and outcrops at various points in its banks for several miles up that stream; outcrops in the south bank of the Ohio River in Campbell County, Kentucky, from Fort Thomas up the river for a number of miles; and in the north bank of the Ohio in Clermont County, Ohio, particularly in the vicinity of Point Pleasant.

At Point Pleasant and at several small streams between Point Pleasant and New Richmond, quarries have been opened in the Trenton, though at present none are worked. The Trenton is much thicker here than has been heretofore reported; the highest stratum of the Trenton is about 130 feet above low-water mark of the Ohio. The lowest 50 or 60 feet are rarely shown, but appear to differ but little lithologically from the strata higher up, which have been

*Geol. Minnesota, III, Part II, 1897, p. ciii.

quarried. From 40 to 50 feet are shown in the quarries, leaving some 30 feet more before reaching the top of the Trenton.

An average section of the exposure in West Covington is as follows:

No. 3.	Crinoidal layer, ...	1 – 2 feet.
No. 2.	Limestone layers with some shale, ...	27 feet.
No. 1.	Layers consisting mainly of bluish shale,	17 feet.
	Concealed to low-water mark, ...	4 feet.
	Total, ...	50 feet.

No. 3. This layer marks the top of the Trenton formation about Cincinnati. Utica shale rests upon its upper surface with more or less unconformity by erosion. It is composed of comminuted fragments, mainly of separated joints of crinoid stems, indiscriminately thrown together and more or less firmly cemented, the arrangement giving evidence of current formation and perturbed changing conditions. The fact that the limestones beneath this layer give place to the shale above it indicates that a very great change had come in geographical conditions. This layer, No. 3, contains several forms restricted to it, most noticeable being the huge *Escharopora ponderosa* (Ulrich), and the *Dendrocrinus dyeri* Meek.

No. 2. This division consists mainly of even-bedded, close-textured, dove-colored limestones, varying from two to six inches or somewhat more in thickness. Some of the layers are semi-crystalline, some so close-textured that all traces of fossils have disappeared, some are a mass of fossils. This last is especially true of the "gastropod layers," in the lower part of this division. On the whole fossils are abundant, but good specimens are not to be easily had. The shale partings between the limestone layers, varying from one to eight inches in thickness are usually barren, but are sometimes very rich in fossils, especially minute ostracoda.

No. 1. These shales are usually bluish and friable, and commonly entirely destitute of fossils. This shale is a variable feature; in some places it is much reduced in thickness, then the limestone division is increased in thickness.

About ten feet below the crinoidal layer (No. 3), a "wavy limestone" layer makes its appearance. No satisfactory explanation has yet been given of the mode of formation of these undulated limestones, which occur also in the Utica and Richmond groups. It is only the upper surface which is waved.

A large and varied fauna has been made known from these Trenton beds, but it is the result of many years' careful searching by many collectors. The meagre results of a day's collecting will no doubt prove disappointing to those visiting the "low river quarries" for the first time. The commonest and most characteristic fossil is the bryozoan *Eridotrypa briareus* (Nicholson). Below is given a list of fossils recorded as occurring in the Point Pleasant beds.*

COELENTERATA.

Tetradium fibratum Safford.

ECHINODERMATA.

Dendrocrinus dyeri (Meek).
" navigiolus Miller.
Iocrinus subcrassus Meek and Worthen, variety.
Lichenocrinus pattersoni Miller.
Merocrinus typus Walcott.
Palæaster dubius Miller and Dyer.

*The lists given in this paper are by no means exhaustive. After all the painstaking collecting of many years new forms are continually being brought to light. Harper and Bassler's Catalogue of the Fossils occurring in the vicinity of Cincinnati, 1896, which gives the ranges of fossils, has been used as a basis in assigning the fossils to the various subdivisions given in this paper. In revising the lists and making corrections where needed, the writer has had the generous help of his friends, Messrs. R. S. Bassler and E. O. Ulrich. The exact horizons at which some of the rare forms have been found are not known; hence these forms may have been assigned to wrong beds. Some species that are given as restricted to certain beds may prove to have a longer range, others may be found to be more restricted than here indicated.

It is unfortunate that there is at Cincinnati no good representative collection of her fossils. The fine collections made in earlier years, which can probably never be duplicated, have been taken away. The magnificent collection of C. B. Dyer, which contained the choicest gatherings of a number of collectors for a long period of years, comprising a very large number of the rare forms, some of them unique, is now the property of the Museum of Comparative Zoölogy, at Harvard University, in Cambridge, Massachusetts. The fine collection of I. H. Harris, of Waynesville, Ohio, which was especially rich in rare Richmond group forms, is now the property of the U. S. National Museum. The latter institution has also recently come into possession of the unrivaled collection of E. O. Ulrich, which contains a very large number of types of bryozoa, gastropoda, lamellibranchs and of other classes. The collection of U. P. James, very rich in bryozoa and also containing many types, has gone to the University of Chicago. The paleontological collection of the Cincinnati Society of Natural History consists mainly of odds and ends which have come to it piecemeal.

BRYOZOA.

Aspidopora calycula (James).
Eridotrypa briareus (Nicholson) (c)*
Eridotrypa mutabilis (Ulrich). (c)
Peronopora sp.
Escharopora ponderosa (Ulrich).

BRACHIOPODA.

Leptobolus lepis Hall.
Lingula covingtonensis Hall and Whitfield.
Lingula modesta Ulrich.
" procteri Ulrich.
" whitfieldi Ulrich.
Lingulops norwoodi (James).
Plectambonites sericeus (Sowerby)
Rafinesquina alternata Conrad-Emmons, variety. (c)
Schizocrania schucherti Hall and Clarke.
Trematis fragilis Ulrich.
Zygospira recurvirostris Hall.

PELECYPODA.

Byssonychia byrnesi Ulrich.
Clionychia subundata Ulrich.
Lyrodesma subplanum Ulrich.
" poststriatum Emmons.
Modiolopsis oblonga Ulrich.
Pyrenomœus subcuneatus Ulrich.
Whiteavesia cancellata (Walcott).
Whiteavesia cincinnatiensis (Hall and Whitfield). (c)
Whiteavesia kentonensis (Ulrich).
" modioliformis (Meek and Worthen).
Whiteavesia pulchella Ulrich.

GASTROPODA.

Archinacella patelliformis (Hall).
Bucania nana Ulrich.
Carinaropsis explanata Ulrich.
Conularia quadrata Walcott.
" trentonensis Hall.
Cyclonema varicosum Hall.
Cyclora depressa Ulrich.
" minuta Hall.
" parvula (Hall).
Cyrtolites parvus Ulrich.
" retrorsus Ulrich.
Cyrtolitina nitidula Ulrich.
Fusispira sulcata Ulrich.
Lophospira abnormis Ulrich.
" oweni Ulrich and Scofield.
Protowarthia cancellata (Hall). (c)
Tetranota bidorsata (Hall).

CEPHALOPODA.

Cameroceras proteiforme (Hall), variety.
Orthoceras albersi Miller.
" junceum Hall.
Orthoceras ludlowense Miller and Faber.
Trocholites ammonius Conrad.

VERMES.

Cornulites sp.
Serpulites dissolutus Billings.

* The (c) following the name of a species indicates that it is a common fossil.

CRUSTACEA.

Asaphus gigas DeKay.
" maximus Locke.
Calymmene callicephala Green.
Ceratopsis intermedia Ulrich.
Gerasaphes ulrichanus Clarke.
Lepidocoleus jamesi (Hall and Whitfield).
Primitia perminima Ulrich.
Primitiella unicornis Ulrich.
Trinucleus concentricus Eaton.
Ulrichia bivertex Ulrich.

POSITION UNCERTAIN.

Bythotrephis gracilis Hall.
" gracilis-crassa Hall.
Lockeia siliquaria James.
Solenopora compacta (Billings).

THE CINCINNATI PERIOD.

The formation comprising the surface strata of southwestern Ohio, southeastern Indiana and northern Kentucky, early known as the Blue Limestone, afterwards as the Cincinnati Group, has now come to be considered one of the major divisions of the Ordovician or Lower Silurian Era, with the title Cincinnati Period. As a whole it consists of clayey or marly, bluish or yellowish shales alternating with even-bedded, rather thin layers of limestone, the latter usually bluish and abundant enough to justify the early designation of Blue Limestone Formation. Occasionally there are layers containing considerable grit. Towards the close of the period considerable beds of sandy material were deposited in some places; e. g., the Cumberland sandstone of Kentucky.

While formerly considered a homogeneous whole, even with the Trenton strata of West Covington included, the Cincinnati period is now known to be easily separable into three divisions important enough to justify the application of the term group. These divisions in descending order are:

3. Richmond group,	between 200 and 300 feet thick.
2. Lorraine group,	310 feet thick.
1. Utica group,	260 feet thick.
Total,	770–870 feet.

There is considerable variation in the different groups in the proportions of limestone and shale. Shale greatly predominates in the Utica, but from the lower beds of the Lorraine on, the proportion of limestone gradually increases. This shows that there was a gradual change from more or less turbulent conditions prevailing at the close of the Trenton to the time of the Lower Richmond, when quiet seas permitted the accumulation of the materials for closely succeeding beds of limestone. As the period came to a close, there came anew turbulent conditions. The fauna of the different groups indicates the same succession of changes.

The character and conditions of the sedimentation would naturally produce strata in which fossils are very abundant. As in the Trenton period preceding, the bryozoa are the most abundant form of life. The quiet interior sea in which these strata were deposited proved a most congenial home for this form of life. Some strata are literally made up of their remains. Next in abundance are the brachiopods. The fragments of the broken shells of the latter sometimes compose beds of considerable thickness. Less than four per cent of all the forms known from the Cincinnati period, and these forms are of course widely distributed and generally subject to considerable variation, are found to range throughout. The great bulk of forms have usually a limited vertical range.

The following is a list of the forms which, as far as present knowledge goes, are found in all the groups of the Cincinnati period:

COELENTERATA.

Labechia? papillata (James). (c)

ECHINODERMATA.

Iocrinus subcrassus Meek and Worthen, and varieties.

BRYOZOA.

Ceramoporella ohioensis (Nicholson). (c)

Stomatopora arachnoidea (Hall). (c)

Stomatopora delicatula (James).

BRACHIOPODA.

Crania scabiosa Hall. (c)
Rafinesquina alternata Conrad-Emmons. (c)
Trematis millepunctata Hall.
Zygospira modesta Say-Hall. (c)

PELECYPODA.

Byssonychia radiata (Hall). (c)
Ctenodonta obliqua Hall.

GASTROPODA.

Cyclora depressa Ulrich.
" hoffmanni Miller.
" minuta Hall. (c)
" parvula Hall.
Lophospira tropidophora (Meek).
Microceras inornatum Hall. (c)
Protowarthia cancellata (Hall). (c)

CEPHALOPODA.

Cameroceras sp. (proteiforme Hall?).

VERMES.

Nereidavus varians Grinnell.

CRUSTACEA.

Aparchites minutissimus (Hall).
Asaphus gigas DeKay.
" maximus Locke.
Bollia persulcata Ulrich (c)
Bythocypris cylindrica (Hall).
Calymmene callicephala Green. (c)
Ulrichia nodosa Ulrich. (c)

POSITION UNCERTAIN.

Arthraria biclavata Miller.
Bythotrephis gracilis Hall.
" gracilis-crassa Hall.
Pasceolus globosus Billings.
Rusophycus bilobatum Vanuxem.

The Utica Group.

The Utica group in its typical exposures in the State of New York is described as consisting of black bituminous slates with a thickness at Utica, New York, of over 600 feet.* The Utica in northern Ohio, as revealed by drillings from the wells at Findlay and other places, is a black shale. Prof. Orton,† comparing the records of drillings, finds that the Utica or black shale thins out towards the south as the Ohio River is approached, but the overlying Hudson River shales, as he calls them, are increased in thickness. The thickness

* Walcott, C. D. The Utica Slate and Related Formations. Trans. Albany Institute, X, 1879, p. 1.

† Geol., Ohio, VI, p. 8.

of the two together is fairly constant. The color is not a matter of much importance. That the shales in southwestern Ohio are bluish or greenish in color, instead of black, does not preclude them from being of Utica age.

The series of shales at Cincinnati overlying the limestone strata now referred to the Point Pleasant beds, was denominated the middle or Eden shales by Prof. Orton.* As there can be no doubt of their Utica age, Prof. Orton's name lapses. Besides holding the same horizon in the geological scale as the New York Utica, the specific identity of several fossils, notably *Triarthrus becki*, very characteristic of the eastern Utica, has been established. Much more could not be asked. Besides being several hundred miles apart, the New York Utica was laid down under very different conditions and comparatively close to the source of its sediments, while the Ohio Utica was formed probably far from land in a large, rather shallow, interior sea. Under the circumstances the latter would have a very much more extensive and different fauna, especially if a barrier of some sort separated the two areas.

The Utica at Cincinnati consists mainly of soft bluish or grayish shales, of which some harden on exposure and others decompose. Some layers form a close approach to marl. To only a very limited extent is it a surface formation, but is often exposed by ravines around the city and by cuttings in the lower slopes of the hills. At no point can a continuous section be studied, nor is it easy to correlate different exposures, as they present great similarity in lithological features and few or none of the common Utica fossils have a short vertical range.

While the group consists mainly of shale, limestones are not altogether wanting, and occasionally a layer of limestone from four to six inches thick, or even more, will be found. The limestone forms, perhaps, one-tenth or one-eighth of the entire mass. Several of the limestones in the lower part are of the waved variety. Some of the shale layers abound in clay concretions. The thickness of the group at Cincinnati is about 260 feet.

* Geol., Ohio, I, 1873, p. 372.

The following list contains the species which range through the Utica.

COELENTERATA.

Climacograptus typicalis Hall.
Dendrograptus gracillimus Lesquereux.
Diplograptus putillus Hall.
Labechia? papillata James. (c)

ECHINODERMATA.

Ectenocrinus grandis (Meek).
" simplex Hall.
Heterocrinus heterodactylus Hall, varieties.
Heterocrinus heterodactylus-propinquus Meek.
Iocrinus subcrassus Meek and Worthen.
Lichenocrinus crateriformis Hall.

BRYOZOA.

Arthrostylus tenuis (James).
Batostoma implicatum (Nicholson). (c)
Bythopora arctipora (Nicholson). (c)
Callopora onealli-communis (James). (c)
Callopora onealli-sigillarioides (Nicholson). (c)
Ceramoporella distincta Ulrich. (c)
Ceramoporella ohioensis (Nicholson). (c)
Cœloclema concentricum (James). (c)
Peronopora vera Ulrich. (c)
Proboscina confusa (Nicholson).
Leptotrypa? clavis Ulrich.
Stomatopora arachnoidea (Hall). (c)
Stomatopora delicatula (James).

BRACHIOPODA.

Crania scabiosa Hall. (c)
Dalmanella multisecta (James-Meek). (c)
Lingula modesta Ulrich.
Plectambonites sericeus (Sowerby). (c)
Rafinesquina alternata Conrad-Emmons. (c)
Trematis millepunctata Hall.
Zygospira modesta Say-Hall.

PELECYPODA.

Byssonychia radiata (Hall). (c)
Clidophorus fabulus Hall.
" planulatus Conrad.
Ctenodonta obliqua (Hall).
" perminuta Ulrich.
Modiolopsis faba Emmons.

GASTROPODA.

Cyclora depressa Ulrich.
" hoffmanni Miller.
" minuta Hall. (c)
" parvula Hall.
Lophospira tropidophora (Meek).
Microceras inornatum Hall. (c)
Protowarthia cancellata (Hall). (c)

CEPHALOPODA.

Cameroceras sp. (proteiforme Hall?).
Orthoceras transversum Miller.

VERMES.

Nereidavus varians Grinnell.

Serpulites dissolutus Billings.

CRUSTACEA.

Acidaspis cincinnatiensis Meek, and varieties.
Acidaspis crossota (Locke).
Aparchites minutissimus (Hall).
Asaphus gigas DeKay.
" maximus Locke.
Bollia persulcata Ulrich (c)
Bythocypris cylindrica (Hall).
Calymmene callicephala Green. (c)
Ceratopsis chambersi (Miller). (c)
Lepidocoleus jamesi (Hall and Whitfield).
Primitia centralis Ulrich.
Ulrichia nodosa (Ulrich). (c)

POSITION UNCERTAIN.

Arthraria biclavata Miller.
Bythotrephis gracilis Hall.
" gracilis-crassa Hall.
Pasceolus globosus Billings.
Rusophycus bilobatum Vanuxem.

Lower Utica or Aspidopora newberryi Beds.

For convenience of study the group may be divided into three subdivisions, more easily distinguished faunally than lithologically, though close study shows lithological differences, which soon come to be felt, but are not easily described.

The lowest division to which the term Lower Utica will be applied, embraces about 80 feet and is on the whole rather unfossiliferous, that is, there are many layers in which fossils are scarce or wanting, but on the other hand there are some layers which are very prolific in fossils; on the whole, the fauna is an abundant one. In the number of species it excels the next two divisions, possibly because there have been more exposures and it has been more carefully hunted than the succeeding divisions. In this division, as in fact throughout the Cincinnati period, the trepostomatous bryozoa are the most abundant fossils in point of number of individuals; perhaps two-thirds of all the fossils are trepostomatous bryozoa. For a faunal designation the term *Aspidopora newberryi* beds is proposed, as this bryozoan is quite a characteristic and fairly abundant species in this division, but very rare, if occurring at all in the succeeding division of the Utica.

Exposures of these beds are constantly becoming rarer. Formerly they were frequently exposed by the various small streams which found their way into the Ohio, but nearly all of these have been transformed into sewers, and their valleys taken for streets and building sites. The lowest shales, occurring in the river bank in the First Ward (Fulton and Columbia), and accessible only in low water of the Ohio River, have yielded a fauna limited to a few feet vertically. Among the forms obtained in these strata are *Palæaster finei*, *Heterocrinus geniculatus*, *Merocrinus curtus*, *Plectambonites plicatellus*, *Ulrichia byrnesi*, *Elpe radiata*, *Triarthrus becki*, *Dicranograptus ramosus*, *Diplograptus whitfieldi*, *Dendrograptus tenuiramosus*, *Aspidopora areolata* and *Aspidopora newberryi*.

The limestones in this division are usually harder and not so bluish as in the remaining Utica strata. The lowest shales are greenish-gray, drab, or yellowish, but soon give way to shales of various shades of blue and gray.

The following list gives the fossils mainly restricted to this division, so far as known. A complete list will include those in the list on pages 68 and 69.

SPONGIÆ.

Lepidolites dickhauti Ulrich.

CŒLENTERATA.

Dendrograptus tenuiramosus Walcott.
Dicranograptus ramosus Hall.
Diplograptus whitfieldi Hall.

ECHINODERMATA.

Glyptocrinus pattersoni Miller.
Heterocrinus exilis Hall.
" geniculatus Ulrich.
Merocrinus curtus Ulrich.
Palæaster finei Ulrich.
Tæniaster fimbriatus (Ulrich).
" flexuosus (Miller and Dyer).

BRYOZOA.

Amplexopora petasiformis (Nicholson).
Amplexopora petasiformis-welchi (James).
Arthropora sp.
Aspidopora areolata Ulrich.
" newberryi (Nicholson).
" sp.
Atactopora hirsuta Ulrich.
Atactoporella newportensis Ulrich.
" typicalis Ulrich.
Callopora onealli (James).
Ceramoporella granulosa Ulrich, variety.
Crepipora solida (Ulrich).
" venusta (Ulrich).

Escharopora acuminata (James).
Hemiphragma whitfieldi (James). (c)
Leptotrypa? cortex Ulrich.
Monotrypa turbinata (James).
Monotrypella æqualis Ulrich.
Rhinidictya parallela (James).
Spatiopora sp.
Stictoporella flexuosa (James).

BRACHIOPODA.

Crania albersi Miller.
" dyeri Miller.
Dalmanella emacerata (Hall).
Leptæna rhomboidalis-gibbosa (James).
Leptobolus insignis Hall.
Lingula bisulcata Ulrich.
Orbiculoidea tenuistriata (Ulrich).
Pholidops cincinnatiensis Hall.
Plectambonites plicatellus (Ulrich).
Rafinesquina ulrichi (James).
Strophomena halliana Miller.
Trematis magna Ulrich.

PELECYPODA.

Byssonychia vera Ulrich.
Ctenodonta filistriata Ulrich.
Cymatonota productifrons Ulrich.
Lyrodesma cincinnatiense Hall.
" poststriatum Emmons.
Modiolopsis subtruncata Ulrich.
Nuculites? yoldiiformis Ulrich.
Orthodontiscus ovatus (Ulrich).
Psiloconcha tenuistriata Ulrich.
Pterinea mucronata Ulrich.
Rhytimya radiata Ulrich.
Technophorus cincinnatiensis Miller and Faber.

GASTROPODA.

Archinacella patelliformis (Hall).
Cyrtolites retrorsus Ulrich.
Fusispira terebriformis Hall.
Liospira micula (Hall).
Lophospira lirata Ulrich.
Tetranota obsoleta Ulrich and Scofield.

CEPHALOPODA.

Orthoceras junceum Hall.

VERMES.

Eotrophonia setigera Ulrich.
Protoscolex covingtonensis Ulrich
" ornatus Ulrich.
Protoscolex simplex Ulrich.
" tenuis Ulrich.

CRUSTACEA.

Elpe radiata (Ulrich).
Jonesella crepidiformis (Ulrich). (c)
Jonesella pedigera Ulrich.
Placentula inornata Ulrich.
Primitia centralis Ulrich.
" rudis Ulrich.
Primitiella claypoli Jones.
Primitiella unicornis Ulrich.
" whitfieldi Jones.
Triarthrus becki Green.
Trinucleus bellulus Ulrich.
" concentricus Eaton.
Ulrichia bivertex Ulrich.
" byrnesi (Miller).

POSITION UNCERTAIN.

Asaphoidichnus dyeri Miller.
" trifidum Miller.
Bythotrephis ramulosa Miller.
Dactylophycus quadripartitum Miller and Dyer.
Dactylophycus tridigitatum Miller and Dyer.
Ormathichnus moniliforme Miller.
Petalichnus multipartitum Miller.
Rusophycus asperum Miller and Dyer.
Sphenophyllum primævum Lesquereux.
Teratichnus confertum Miller.
Trachomatichnus cincinnatiense Miller.
Trachomatichnus numerosum Miller.
Trachomatichnus permultum Miller.
Trichophycus sulcatum Miller and Dyer.

Middle Utica or Batostoma jamesi Beds.

No sharp dividing lines can be drawn separating this series of beds from either the lower or upper Utica. The thickness is about 120 feet. This division has a somewhat less proportion of limestone than the other divisions of the Utica and is much less rich faunally. Exposures are not uncommon, but are rarely of a character to yield many fossils; that is, they usually show the edges of the outcropping strata, but are seldom thrown out and given a chance to weather. From the abundance of the bryozoan *Batostoma jamesi* (Nicholson) the beds may be known as the *Batostoma jamesi* beds.

In addition to the fossils given in the list of those ranging through the Utica, the following occur, most of which are restricted to this division:

CŒLENTERATA.

Dictyonema arbusculum (Ulrich).

ECHINODERMATA.

Lichenocrinus dubius Miller.

BRYOZOA.

Amplexopora petasiformis (Nicholson), variety.
Aspidopora eccentrica (James).
Batostoma implicatum (Nicholson). (c).
Batostoma jamesi (Nicholson). (c).
Bythopora arctipora (Nicholson).
Callopora onealli - communis (James). (c).
Callopora onealli - sigillarioides (Nicholson). (c).
Callopora sp.
Ceramoporella distincta Ulrich.
" granulosa Ulrich, variety.

Ceramoporella ohioensis (Nicholson).
Cœloclema alternatum (James).
Dekayella ulrichi (Nicholson).
Hemiphragma whitfieldi (James), variety.
Peronopora vera Ulrich. (c).
Proboscina confusa (Nicholson).

BRACHIOPODA.

Dalmanella emacerata (Hall).
Pholidops cincinnatiensis Hall.
Rafinesquina squamula (James).
Strophomena halliana Miller.

PELECYPODA.

Clidophorus ellipticus Ulrich.
Lyrodesma conradi Ulrich.
Modiolopsis angustata Ulrich.
" parva Ulrich.
" simulatrix Ulrich.
Orthodesma occidentale Miller.
Orthodontiscus mediocardinalis (Miller).
Orthodontiscus ovatus (Ulrich).
Psiloconcha minima Ulrich.

GASTROPODA.

Archinacella patelliformis (Hall).
Cyrtolites carinatus Miller.
Hormotoma gracilis - angustata Hall.
Liospira micula (Hall).
Lophospira lirata Ulrich.
Protowarthia granistriata Ulrich.
" planidorsata Ulrich.
Trochonema nitidum Ulrich.

CEPHALOPODA.

Cyrtoceras magister Miller.
" ortoni (Meek).
" ventricosum Miller.
Trocholites minusculus Miller and Dyer.

CRUSTACEA.

Proetus spurlocki Meek.
Ctenobolbina ciliata (Emmons). (c).

Upper Utica or Dekayella ulrichi Beds.

This division of the Utica is exceedingly fossiliferous, but the fauna is mainly of a bryozoan character. Limestones, especially of a thin, slabby kind, are considerably more numerous than in the divisions below, two heavy layers being usually found at its bottom. Although *Dekayella ulrichi* (Nicholson) occurs plentifully in the middle Utica, it is so very abundant in these beds that the name *Dekayella ulrichi* beds seems an appropriate faunal designation. The thickness of this division is about sixty feet. The beds have been frequently exposed in grading for streets and other purposes, so that the fauna is fairly well known.

In addition to the fossils in the list on pages 68 and 69, the following are found in the upper Utica:

BRYOZOA.

Amplexopora septosa (Ulrich).
Arthropora shafferi-cleavelandi (James).
Atactopora hirsuta Ulrich.
Batostoma jamesi (Nicholson). (c)
Berenicea vesiculosa Ulrich.
Bythopora parvula James.
Callopora nodulosa (Nicholson).
Ceramoporella granulosa Ulrich, variety.
Ceramoporella granulosa - milfordensis (James).
Cœloclema alternatum (James). (c)
Constellaria constellata - prominens Ulrich.
Crepipora simulans Ulrich.
Dekayella obscura Ulrich.
" ulrichi (Nicholson). (c)
" ulrichi-robusta Foord.
Dekayia maculata (James).
Escharopora falciformis (Nicholson), variety.
Phylloporina variolata (Ulrich).
Stomatopora arachnoidea - tenuissima Ulrich.

GASTROPODA.

Bellerophon capax Ulrich.

CRUSTACEA.

Ctenobolbina alata Ulrich.
" bispinosa Ulrich.
Ctenobolbina ciliata-curta Ulrich.

POSITION UNCERTAIN.

Rusophycus pudicum Hall.
Protostigma sigillaroides Lesquereux.

The Lorraine Group.

The Lorraine at Cincinnati as compared with the underlying Utica contains much less shale and more limestone. The shales are bluish or yellowish, and often marly. The limestones are even-bedded, on an average four or five inches thick, and bluish in color. No markedly waved layers have been observed in the Lorraine. All the higher strata at Cincinnati belong to the Lorraine, and for twenty or thirty miles around the city the streams expose these strata. The Lorraine is also found in Kentucky and Tennessee. Mt. Parnassus at Columbia, Tennessee, is a noted locality for Lorraine fossils.

The Lorraine in Ohio is easily separable on faunal grounds, with corresponding more or less well-marked lithological characters, into six series of beds or subdivisions. In descending order these are:

6. Warren or *Homotrypa bassleri* Beds, . . . about 80 feet.
5. Mt. Auburn or *Platystrophia lynx* Beds . . . about 20 feet.
4. Corryville or *Chiloporella nicholsoni* Beds, . . about 60 feet.
3. Bellevue or *Monticulipora molesta* Beds, . . . about 20 feet.
2. Fairmount or *Dekayia aspera* Beds, ... about 80 feet.
1. Mt. Hope or *Amplexopora septosa* Beds, . . about 50 feet.

The Lorraine is exceedingly fossiliferous. Throughout the trepostomatous bryozoa are very abundant. Some forms it has in common with the underlying Utica and the overlying Richmond, yet the number is surprisingly small in comparison with the entire fauna. Owing to their usually having a restricted range, the bryozoa are excellent horizon markers.

The species which range through the Lorraine, though in some beds, as, e. g., the Bellevue Beds, they may occur very rarely, are as follows:

COELENTERATA.

Labechia? papillata (James). (c)

ECHINODERMATA.

Heterocrinus heterodactylus Hall, varieties.
Iocrinus subcrassus Meek and Worthen, varieties.
Lepidodiscus cincinnatiensis (Rœmer).

BRYOZOA.

Ceramoporella ohioensis (Nicholson) (c)
Stomatopora arachnoidea (Hall). (c)
Stomatopora delicatula (James).

BRACHIOPODA.

Crania lælia Hall.
" scabiosa Hall (c)
Hebertella sinuata (Hall). (c)
Platystrophia laticostata (James-Meek), and varieties. (c)
Rafinesquina alternata Conrad-Emmons. (c)
Trematis millepunctata Hall.
Zygospira modesta Say-Hall. (c)

PELECYPODA.

Byssonychia radiata (Hall). (c)
Clidophorus fabulus (Hall).
Ctenodonta obliqua (Hall).
Ctenodonta perminuta Ulrich.
Pterinea demissa Conrad (c)

GASTROPODA.

Coleolus iowensis James.
Conularia formosa Miller and Dyer.
Cyclora depressa Ulrich.
" hoffmanni Miller.
" minuta Hall. (c)
" parvula Hall.
Cyrtolites ornatus Conrad. (c)
Hyolithes parviusculus Hall
Lophospira bowdeni (Safford).(c)
" tropidophora (Meek).
Microceras inornatum Hall. (c)
Protowarthia cancellata (Hall).(c)
Shizolopha moorei Ulrich.

CEPHALOPODA.

Cameroceras sp. (proteiforme Hall?).

VERMES.

Cornulites corrugatus(Nicholson).
" sterlingensis (Meek and Worthen).
Nereidavus varians Grinnell.
Serpulites dissolutus Billings.

CRUSTACEA.

Acidaspis cincinnatiensis Meek, and varieties.
Aparchites minutissimus (Hall).
Bollia persulcata Ulrich. (c)
Bythocypris cylindrica (Hall).
Calymmene callicephala Green. (c)
Isotelus gigas DeKay.
" maximus Locke.
Lepidocoleus jamesi (Hall and Whitfield.
Ulrichia nodosa (Ulrich). (c)

POSITION UNCERTAIN.

Arthraria biclavata Miller.
Bythotrephis gracilis Hall.
" gracilis-crassa Hall.
Pasceolus globosus Billings.
Rusophycus bilobatum Vanuxem.
" pudicum Hall.

Mt. Hope or Amplexopora septosa Beds.

Overlying the Utica are several heavy, rather irregularly bedded limestones roughish in character. The layer of limestone which usually caps the Utica shale varies from eight to sixteen inches in thickness. It is a mass of fossils, mainly *Dalmanella multisecta;* the reddish specimens of this little shell sprinkling its upper surface render it an easily recognized stratum. This and several succeeding limestone layers are sometimes quarried but do not afford a very satisfactory

building stone; they do not dress well, and are usually so situated as not to be worked with profit. In Newport, Kentucky, they are about 300 feet above the Cincinnati city datum, low-water mark of the Ohio river, which is 432 feet above tide.

The horizon of the *Strophomena planoconvexa*, which has a very limited vertical range, is regarded as marking the boundary between the Mt. Hope beds and the succeeding Fairmount beds. Limestones are more abundant than in the upper Utica, but not so abundant as in the Fairmount beds, and these, and the intervening shales as well, are often inclined to be sandy. Occasionally there are layers showing the fossils as casts upon weathering. The few feet of limestones and intervening shales capping the upper Utica beds are crowded with bryozoa of about the same kinds as the beds just below them, but fossils soon become scarcer, and as a whole these beds appear to have a rather meager fauna. This may be only apparent, however, due to their rarely being exposed. The name Mt. Hope beds has been given from an exposure found on the southeastern slope of Price Hill, known as Mt. Hope, where the strata are more clayey and less sandy than usual and the fossils better preserved. Although the *Amplexopora septosa* occurs rather sparingly in the upper Utica, it is very characteristic and abundant and finely developed in these beds, and so has been selected for the faunal designation.

In addition to the species ranging through the Lorraine, the following are found in these beds:

SPONGIÆ.

Anomalospongia reticulata Ulrich.

BRYOZOA.

Amplexopora septosa (Ulrich). (c)
Batostoma sp.
Callopora dalei (Edwards and Haime). (c)
Callopora nodulosa (Nicholson).
" subplana Ulrich.
Constellaria constellata-plana Ulrich.
Constellaria constellata-prominens Ulrich.
Dicranopora emacerata (Nicholson).
Heterotrypa sp.
Monticulipora mammulata D'Orbigny.
Peronopora vera Ulrich. (c)

BRACHIOPODA.

Dalmanella multisecta (James-Meek).

PELECYPODA.

Ctenodonta pectunculoides (Hall)

Modiolopsis milleri Ulrich.

GASTROPODA.

Cyclonema gracile Ulrich.

VERMES.

Arabellites lunatus Hinde.

" quadratus Hinde.

Eunicites simplex Hinde.

Lumbriconereites dactylodus Hinde.

Scolithus tuberosus Miller and Dyer.

POSITION UNCERTAIN.

Discophycus typicale Walcott.

Fairmount or Dekayia aspera Beds.

This division of the Lorraine was early known as the Stone Quarries and later by Orton's name, Hill Quarry beds. The name Fairmount is proposed because all the hills in that part of the city known as Fairmount, lying north from Price Hill and south or southwest from Cumminsville and immediately west of Mill Creek, in which numerous quarries have been opened, show these strata and none higher. The highest strata in the hills surrounding Newport and Covington also belong to this division. These beds, whose thickness is about eighty feet, are characterized by regular aternations of evenly-bedded, bluish limestones from two to six inches thick, rarely more, and bluish or sometimes pale yellowish or brownish shales. The limestones form at least a third of the whole mass and are easily quarried out. The stone is mostly used for foundation work for residences, though it has also been very tastefully employed to form the walls of a number of church edifices and other buildings of a quasi-public character. The stone when burned forms a rather strong lime, which has a limited use locally. At one time the making of lime was quite an industry, but the purer grades of lime shipped in have almost displaced the home-made article.

With this division the Lorraine fauna is fairly inaugurated. The fauna is quite different from that in the Utica beds. Fossils cannot be said to be really abundant, that is, as compared with the upper Utica or the succeeding divisions of the Lorraine, but in variety the Fairmount beds excel all other divisions of the Cincinnati period, with the possible exception of the lower Richmond. The fossils are usually well, and often beautifully preserved, and can ordinarily be had free through the weathering of the shales between the limestones. The limestone layers usually show the fossils of which they are composed, and their upper and lower surfaces are often a mass of fossils, projecting more or less from the matrix.

In addition to the forms which range through the Lorraine the following occur in the Fairmount beds:

SPONGIÆ.

Cylindrocœlia covingtonensis Ulrich.
Dystactospongia insolens Miller.
Hindia sphæroidalis-gregaria Miller and Dyer.

ECHINODERMATA.

Anomalocrinus incurvus (Meek and Worthen).
Cyclocystoides bellulus Miller and Dyer.
Cystaster granulatus (Hall).
Dendrocrinus cincinnatiensis (Meek).
Ectenocrinus grandis (Meek).
Glyptocrinus decadactylus Hall.
Hemicystites stellatus (Hall).
Ohiocrinus laxus (Hall).
" oehanus (Ulrich).
Palæaster clarkanus Miller.
" dyeri Meek.
" granulosus Hall.
" jamesi (Dana).
" shafferi Hall.
Ptychocrinus parvus (Hall).
Streptaster vorticellatus (Hall).
Tæniaster granuliferus (Meek).

BRYOZOA.

Amplexopora cingulata Ulrich.
" ? discoidea (Nicholson).
Amplexopora septosa (Ulrich).
" sp.
Arthropora shafferi (Nicholson), variety.
Arthropora sp.
Atactopora hirsuta Ulrich.
" maculata Ulrich.
Atactoporella multigranosa (Ulrich).
Atactoporella mundula (Ulrich).
" tenella (Ulrich).
Bythopora dendrina (James).
" gracilis (Nicholson). (c)
Callopora dalei (Edwards and Haime). (c)
Callopora subplana Ulrich.

Callopora sp.
Ceramoporella distincta Ulrich.
" granulosa Ulrich, variety.
Ceramoporella ohioensis (Nicholson). (c)
Constellaria constellata Dana. (c)
" constellata-plana Ulrich.
Crepipora impressa Ulrich.
" simulans Ulrich.
Dekayia aspera Edwards and Haime. (c)
Dekayia multispinosa Ulrich.
Dicranopora emacerata (Nicholson).
Dicranopora internodia (Miller and Dyer).
Discotrypa elegans (Ulrich).
Escharopora falciformis (Nicholson).
Escharopora maculata Ulrich.
" pavonia (D'Orbigny). (c)
Heterotrypa frondosa (D'Orbigny). (c)
Heterotrypa solitaria Ulrich.
" subpulchella (Nicholson).
Heterotrypa sp.
Homotrypa curvata Ulrich.
" flabellaris Ulrich.
" obliqua Ulrich. (c)
" sp.
Homotrypella sp.
Leptotrypa? irregularis (Ulrich).
" ? semipilaris Ulrich.
Monticulipora mammulata D'Orbigny.
Peronopora vera Ulrich.
Petigopora gregaria Ulrich.
" petechialis (Nicholson).
Phylloporina clathrata (Miller and Dyer).
Spatiopora aspera Ulrich.
" corticans (Nicholson).
" lineata Ulrich.
" maculosa Ulrich.
" tuberculata (Edwards and Haime).
Stomatopora inflata (Hall).

BRACHIOPODA.

Dalmanella bellula (James-Meek).
" meeki (Miller).
Lingula cincinnatiensis (Hall and Whitfield).
Lingula modesta Ulrich.
Orthorhynchula linneyi (James-Nettleroth).
Pholidops cincinnatiensis Hall.
Platystrophia crassa (James-Meek).
Plectorthis dichotoma (Hall).
" ? ella (Hall).
" æquivalvis (Hall).
" fissicosta (Hall).
" plicatella (Hall). (c).
" ? sectostriata (Ulrich)
" triplicatella (Meek).
Rafinesquina alternata-fracta (Meek).
Rafinesquina alternata-loxorhytis (Meek).
Rafinesquina squamula (James).
Schizambon? lockii Winchell and Schuchert.
Schizocrania filosa Hall and Whitfield.
Strophomena planoconvexa Hall.
" sinuata James-Meek.
Trematis crassipunctata Ulrich.
" dyeri Miller.
" oblata Ulrich.
Zygospira cincinnatiensis James-Meek.
Zygospira concentrica Ulrich.

PELECYPODA.

Allonychia ovata Ulrich.
Anomalodonta plicata Ulrich.
Byssonychia acutirostris Ulrich.
" imbricata Ulrich.
" retrorsa (Miller).
Ctenodonta pectunculoides (Hall).
Cuneamya cordiformis Miller.
" parva Miller.
Cymatonota pholadis (Conrad).
" recta Ulrich.
Eridonychia apicalis Ulrich.
" paucicostata Ulrich.
Eurymya alata (Ulrich).
Ischyrodonta unionoides (Meek).
Lyrodesma grande Ulrich.
" inornatum Ulrich.
Modiolodon obtusus Ulrich.
" truncatus (Hall).
Modiolopsis faba Emmons.
" faberi Miller.
" longa Miller and Faber.
" milleri Ulrich.
" modiolaris (Conrad).
" parallela Ulrich.
Opisthoptera ampla Ulrich.
Opisthoptera notabilis Ulrich.
Orthodesma faberi Miller.
" nasutum Conrad.
Orthonotella faberi Miller.
Physetomya acuminata Ulrich.
Psiloconcha inornata Ulrich.
" sinuata Ulrich.
" subovalis (Ulrich).
Pterinea cincinnatiensis Miller and Faber.
Pterinea rugatula Miller and Faber.
Pyanomya faberi Miller.
" gibbosa Miller.
Rhytimya ashmani Miller and Faber.
Rhytimya compressa Ulrich.
" oehana Ulrich.
" producta Ulrich.
" scaphula Miller and Faber.
Sedgwickia? compressa Meek.
" ? fragilis Meek.
Technophorus faberi Miller.
" punctostriatus Ulrich.

GASTROPODA.

Bellerophon capax Ulrich.
Bucanopsis carinifera Ulrich.
Clathrospira conica Ulrich and Scofield.
Conradella bellula Ulrich.
Cyclonema inflatum Ulrich.
" limatum Ulrich.
Cyclonema mediale Ulrich.
" pyramidatum James.
" sublæve Ulrich.
" transversum Ulrich.
Lophospira ampla Ulrich.
Microceras minutissimum Ulrich.
Seelya mundula Ulrich.

CEPHALOPODA.

Cyrtoceras conoidale Wetherby.
" vallandighami Miller.
Orthoceras byrnesi Miller.
" cincinnatiense Miller.
Orthoceras meeki Miller.
" turbidum Hall and Whitfield.

VERMES.

Arabellites aciculatus James.
" hindei James.
Cornulites flexuosus (Hall).
Cornulites minor Nicholson.
Walcottia rugosa Miller and Dyer.

CRUSTACEA.

Acidaspis anchoralis Miller.
Ctenobolbina? tumida Ulrich.
Dalmanites callicephalus Hall.
Dalmanites carleyi Meek.
Elpe cincinnatiensis (Meek).

POSITION UNCERTAIN.

Heliophycus stelliforme Miller and Dyer.
Trichophycus venosum Miller.

Bellevue or Monticulipora molesta Beds.

Overlying the quarry layers is a small series of beds, of rather shelly limestone, thinner than those below and harder, which the eye readily distinguishes as quite different from the layers below. In the bluff at the bend in Clifton Avenue, just under the old Bellevue House, a one-time landmark which has recently disappeared, these layers project out boldly near the top of the bluff, above the strata of the Fairmount beds. The beds are almost a mass of bryozoa, and hence contain few other fossils. The *Monticulipora molesta* which, if not restricted to these beds, at least here attains its maximum development in size and numbers, is one of the most characteristic of these bryozoa and has been chosen for the faunal designation. The thickness of these beds is about fifteen feet.

Immediately above are about five feet considerably different lithologically and somewhat faunally, which we include in this division. These upper layers are largely composed of single valves and broken fragments of *Rafinesquina alternata*, variety, though entire specimens are not uncommon. The *M. molesta* occurs also in these layers, but has not been found in the next division.

In addition to the forms ranging through the Lorraine, the following occur:

BRYOZOA.

Amplexopora filiosa (D'Orbigny).
" robusta Ulrich.
Atactoporella multigranosa (Ulrich).
Atactoporella mundula (Ulrich).
" ortoni (Nicholson).
" tenella (Ulrich).
Atactoporella sp.
Bythopora gracilis (Nicholson). (c).
Callopora ramosa (D'Orbigny). (c)
Ceramoporella granulosa Ulrich, variety.

Ceramoporella whitei (James).
" sp.
Dekayia sp.
Heterotrypa sp.
Homotrypa obliqua Ulrich. (c)
Monticulipora molesta Nicholson. (c)
Nicholsonella vaupeli Ulrich.
Peronopora compressa (Ulrich).
Peronopora decipiens (Rominger).
Petigopora asperula Ulrich.
" gregaria Ulrich.
" petechialis Nicholson.
Proboscina auloporoides (Nicholson).
Proboscina frondosa (Nicholson).
Stomatopora inflata (Hall).

BRACHIOPODA.

Platystrophia lynx (Eichwald), variety.
Schizocrania filosa Hall and Whitfield.

Corryville or Chiloporella nicholsoni Beds.

In this division the limestones are thinner and less frequent than in the quarry beds and the shales more yellowish. Blue shale also occurs. Price Hill and the higher hills of the "Cincinnati island" (see *ante*, p. 50) expose these beds. Formerly Corryville abounded in exposures, but has been so covered with residences that the underlying strata are now seldom seen. One of the most characteristic bryozoa, very abundant in these beds, if not restricted to them, is the *Chiloporella nicholsoni*. At the present time Fairview Heights affords a number of exposures of these layers. Owing to these strata having been largely cut into in the course of the transformation of the hill tops into the residence portion of the city, their fauna has become well known.

In addition to the species ranging through the Lorraine, the following occur:

SPONGIÆ.

Leptopoterion mammiferum Ulrich.
Pattersonia difficilis Miller.
" ulrichi Rauff.

ECHINODERMATA.

Anomalocrinus caponiformis (Lyon).
Anomalocystites balanoides Meek.
Cyclocystoides cincinnatiensis Miller and Faber.
Cyclocystoides nitidus Faber.
Dendrocrinus posticus (Hall).
Glyptocrinus dyeri Meek.
" dyeri-sublævis Miller.
" subglobosus Meek.
Heterocrinus pentagonus Ulrich.
Lepidodiscus holbrooki (James).
" pileus (Hall).
" warrenensis (James).

Lichenocrinus dyeri Hall.
Ohiocrinus compactus (Meek).
" constrictus (Hall).
Palæaster incomptus Meek.
Palæaster spinulosus Miller and Dyer.
Streptaster? verticellatus (Hall).

BRYOZOA.

Amplexopora filiosa (D'Orbigny).
Arthropora shafferi (Meek).
Atactopora sp.
Berenicea primitiva Ulrich.
" sp.
Bythopora dendrina (James).
" gracilis (Nicholson).(c)
Callopora andrewsi (Nicholson).
" ramosa (D'Orbigny). (c)
" rugosa (Edwards and Haime). (c)
Callopora sp.
Ceramoporella granulosa Ulrich, variety.
Ceramoporella whitei (James).
" sp.
Chiloporella nicholsoni (James) (c)
Dekayia appressa Ulrich.
" pelliculata Ulrich.
Heterotrypa inflecta Ulrich.
Homotrypa obliqua Ulrich. (c)
Monticulipora cincinnatiensis (James).
Peronopora compressa (Ulrich.) (c)
" decipiens (Rominger).
Petigopora asperula Ulrich.
" gregaria Ulrich.
" petechialis Nicholson.
Proboscina auloporoides (Nicholson).
Proboscina frondosa (Nicholson).
Spatiopora tuberculata (Edwards and Haime).
Spatiopora sp.
Stomatopora inflata (Hall).

BRACHIOPODA.

Platystrophia sp.
Rafinesquina alternata - nasuta (Conrad). (c)
Schizocrania filosa Hall and Whitfield.
Trematis umbonata Ulrich.

PELECYPODA.

Allonychia jamesi (Meek).
" subrotunda Ulrich.
Byssonychia alveolata Ulrich.
" præcursor Ulrich.
Cardiomorpha obliquata Meek.
Cuneamya elliptica Miller.
Modiolodon truncatus (Hall).
Modiolopsis faba Emmons.
Orthodesma mundum Miller and Faber.
Orthodesma parvum Ulrich.
Psilonychia perangulata Ulrich.
Pyrenomœus decipiens Ulrich.
Rhytimya convexa Ulrich.
" mickelboroughi (Whitfield).

GASTROPODA.

Bellerophon recurvus Ulrich.
Conradella elegans (Miller).
Cyclonema humerosum Ulrich.
Cyclonema simulans Ulrich.
Dyeria costata (James).

CEPHALOPODA.

Gomphoceras cincinnatiense Miller.
Gomphoceras faberi Miller.
Orthoceras dyeri Miller.
" harperi Miller.

VERMES.

Walcottia cookana Miller and Dyer.

CRUSTACEA.

Ceratopsis oculifera (Hall).
Ceraurus milleranus Miller and Gurley.
Ctenobolbina duryi (Miller).
Elpe cincinnatiensis (Meek).
Elpe irregularis (Miller).
Lichas halli Foerste.
Placentula marginata Ulrich.
Primitia centralis Ulrich.
Proetus parviusculus Hall.

POSITION UNCERTAIN.

Blastophycus diadematum Miller and Dyer.
Bythotrephis ramulosa Miller.
Licrophycus flabellum Miller and Dyer.

Mt. Auburn or Platystrophia lynx Beds.

These beds were selected by Prof. Orton to mark the dividing line between the Cincinnati beds proper and the Lebanon division, but their thickness is much greater than was probably suspected. At Cincinnati but few localities have an altitude great enough to show them. The city water tanks on Price Hill rest on them; the higher parts of McMillan Street, on Clifton Heights, were cut through them. Over a considerable part of Mt. Auburn they formed the surface rock with numerous exposures before the growth of the city covered this beautiful hilltop with residences. The high ridge extending from west of Price Hill north through Westwood shows these beds wherever cut into. They are finely exposed in Reservoir Creek, north of Lebanon, Ohio. Their thickness is about twenty feet. The lower five to twelve feet contain an abundance of the large Orthid, *Platystrophia lynx*, known in common parlance as double-headed Dutchman; in the remainder this brachiopod is much less abundant, otherwise the fauna is much the same. The most characteristic bryozoa are the *Cœloclema oweni* and a fine species of *Homotrypa* as yet undescribed. The beds are mainly blue shale, though sometimes yellowish in exposure, with some rather

irregularly bedded limestone. The following fossils occur in addition to those listed on pages 75 and 76. The fauna is mainly bryozoan. These beds have not received much attention at the hands of collectors, which may explain the brevity of the following list:

BRYOZOA.

Amplexopora sp. (c)
Arthropora shafferi (Meek).
Atactoporella sp.
Berenicea sp.
Bythopora gracilis (Nicholson). (c)
Callopora sp.
Ceramoporella whitei (James).
Cœloclema oweni (James). (c)
Crepipora simulans Ulrich.
Dekayia sp.
Dicranopora emacerata (Nicholson).
Eridotrypa sp.
Heterotrypa sp.
Homotrypa sp. (c).
Peronopora compressa (Ulrich).
" decipiens (Rominger).
Petigopora petechialis (Rominger).
Proboscina frondosa (Nicholson).
Stomatopora inflata Hall.

BRACHIOPODA.

Platystrophia lynx (Eichwald). (c)

Warren or Homotrypa bassleri Beds.

The Mt. Auburn beds pass with little distinction into the next series of beds. For these the name Warren beds is proposed, because they are exposed in a number of streams in the vicinity of Lebanon, Oregonia, and other places in Warren County. The most characteristic bryozoan is perhaps the *Homotrypa bassleri*.* These strata were included by Orton in the Lebanon beds, but their fauna shows them to be much more nearly related to the Lorraine beds beneath than to the Richmond above. Toward the top of this division the layers, both limestone and shale, especially the latter, become rough and nodular, indicating a marked change in the sedimentation. For this reason these layers are considered to mark the close of the Lorraine. Immediately after them come the even-bedded limestones and marly shales of the lower Richmond. Limestone is not very abundant in the beds under consideration, whose thickness is about eighty feet. The intercalated shales are of a dark bluish color, rather marly.

* For description of this species see this journal, Vol. XX., Article IV.

Fossils do not appear to be nearly as abundant as in beds underlying or overlying. But these beds have received little attention from collectors. Careful collecting may show a large and varied, as well as characteristic fauna.* About thirty-five feet below the top of these beds occurs the stratum of the noted *Dinorthis retrorsa* (Salter), of very limited extent vertically, but very persistent horizontally. This Orthid is abundant in this stratum, but seems to be restricted to it.

The following species are considered to occur in the Warren beds in addition to those given as ranging through the Lorraine:

BRYOZOA.

Amplexopora sp.
Batostoma varians (James). (c)
Berenicea sp.
Callopora sp.
Ceramoporella granulosa Ulrich, variety.
Ceramoporella whitei (James).
" sp.
Cœloclema sp.
Heterotrypa sp.
Homotrypa bassleri Nickles. (c)
Leptotrypa? dychei (James).
Lioclemella sp.
Mesotrypa sp.
Nicholsonella sp.
Peronopora compressa (Ulrich).
" decipiens (Rominger).
Proboscina frondosa (Nicholson).
Rhopalonaria venosa Ulrich.

BRACHIOPODA.

Dinorthis retrorsa (Salter).

PELECYPODA.

Anomalodonta alata Meek.
Ctenodonta madisonensis Ulrich.
Cymatonota constricta Ulrich.
Cymatonota cylindrica (Miller and Faber).
Modiolodon subovalis Ulrich.

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*It is quite probable that a few of the forms, which in this paper are listed as belonging to the lower Richmond, will prove to belong to the Warren beds. The recognition of the fact that the Cincinnati period consists of the three well-marked groups, Utica, Lorraine, and Richmond, is comparatively recent. And still more recently has it been seen that in each are well-marked divisions, easily recognized when once the faunal and lithological differences are known. A very large number of the fossils described from the Cincinnati period are rare forms; some are unique, but a single specimen being known. So long as the idea prevailed that the Cincinnati group, as it was then called, was homogeneous and indivisible, collectors were indifferent as to the exact horizon of their finds. Hence, when those who described fossils, give simply Cincinnati, Ohio, as the locality, it is often a matter of conjecture from just which particular division the fossil came. For this reason the lists given in this paper must be considered largely provisional. I have to acknowledge gratefully the very great help I have received in placing the fossils in their various beds from my friends, Messrs. E. O. Ulrich and R. S. Bassler, whose full and accurate knowledge of the Cincinnati fossils and their horizons has been freely at my service.

GASTROPODA.

Cyclonema bilix-fluctuatum James.
Cyclora pulcella Miller.

CEPHALOPODA.

Orthoceras mohri Miller.

VERMES.

Polygnathus wilsoni James.
Prioniodus dychei James.

CRUSTACEA.

Aparchites oblongus Ulrich.
Ctenobolbina ciliata - hammelli (Miller and Faber).
Primitia cincinnatiensis (Miller). (c)

POSITION UNCERTAIN.

Dystactophycus mamillanum Miller and Dyer.

The Richmond Group.

The Richmond embraces the uppermost beds of the Cincinnati period. In Ohio and Indiana they form an irregular belt, surrounding Cincinnati at a distance of from thirty to fifty miles. The localities in these States most noted for their fossils are Lebanon (not in the immediate vicinity, however), Freeport or Oregonia, Waynesville, Clarksville, Morrow, Westboro, Blanchester, Camden, and Oxford in Ohio; Richmond, Weisburg, Versailles, and Madison in Indiana.

The rocks are even-bedded limestones, usually dove-colored or grayish rather than bluish, from two to ten or more inches in thickness, with regular shale alternations, the limestone forming from one-fourth to one-half the whole mass.

The Richmond has received but little careful, detailed study, not enough to establish the boundaries or lithological characters of the divisions. The indications are that there are three well marked divisions, which for the present are designated as lower, middle, and upper Richmond. The lower Richmond seems to be strongly developed on the eastern side of the Cincinnati uplift, where the middle is feebly developed and the upper probably not at all. The middle division is finely shown at Richmond, Indiana, and at other points on the western side of the uplift. On this same

side the upper is feebly developed toward the north, but becomes stronger toward the south, and probably has its strongest development in Kentucky. The Cumberland sandstone of Kentucky probably belongs to this division. The Richmond beds of Tennessee,* and those formed in the western and northwestern parts of the ancient interior sea, now exposed at Wilmington and Sterling, Illinois, and Spring Valley, Minnesota, perhaps also those shown at Delafield and Iron Ridge, Wisconsin, all of which have been referred to the Cincinnati period, may represent a phase later than any of the Richmond of Ohio and Indiana.

The Richmond group has a very extensive and varied fauna, and, as a whole, very different from the underlying Lorraine. Corals are unknown in the Lorraine, the Richmond has a considerable number. The bryozoan fauna of both lower and middle Richmond is very extensive; many new species of bryozoa have been discovered which await description.

The following list contains the species which, so far as present knowledge goes, range through the Richmond.

COELENTERATA.

Labechia? papillata (James). (c)
Protarea vetusta (Hall), variety. (c)
Streptelasma rusticum Billings. (c)

ECHINODERMATA.

Iocrinus subcrassus Meek and Worthen, varieties.

BRYOZOA.

Berenicea sp.
Ceramoporella granulosa Ulrich, variety.
Ceramoporella ohioensis (Nicholson). (c)
Constellaria polystomella Nicholson.
Fenestella granulosa Whitfield.
Homotrypa flabellaris Ulrich. (c)
Homotrypella sp.
Monotrypella quadrata (Rominger). (c).
Monotrypella subquadrata Ulrich.
Peronopora decipiens (Rominger). (c)
Prasopora hospitalis (Nicholson).
Stomatopora arachnoidea (Hall). (c)
Stomatopora delicatula (James).
" inflata (Hall).

* For many of the facts in this paragraph I am indebted to Mr. E. O. Ulrich, whose field investigations, particularly in Tennessee, promise to throw a great deal of light upon the Richmond and other Ordivician formations.

BRACHIOPODA.

Crania lælia Hall.
" scabiosa Hall. (c)
Hebertella occidentalis Hall.
" sinuata Hall.
Platystrophia laticostata (James-Meek), varieties.
Rafinesquina alternata Conrad-Emmons. (c)
Rhynchotrema capax (Conrad). (c)
Trematis millepunctata Hall.
Zygospira modesta Say-Hall.

PELECYPODA.

Byssonychia radiata (Hall). (c)
Ctenodonta obliqua (Hall).
Ctenodonta recurva Ulrich.
Pterinea demissa Conrad. (c)

GASTROPODA.

Coleolus iowensis James.
Conularia formosa Miller and Dyer.
Cyclonema bilix (Conrad).
" bilix-fluctuatum James.
Cyclora depressa Ulrich.
" hoffmanni Miller.
" minuta Hall. (c)
Cyclora parvula (Hall).
Hyolithes parviusculus Hall.
Lophospira bowdeni Safford. (c)
" tropidophora (Meek).
Microceras inornatum Hall. (c)
Protowarthia cancellata (Hall). (c)
Schizolopha moorei Ulrich.

CEPHALOPODA.

Cameroceras sp. (proteiforme Hall?).

VERMES.

Cornulites sterlingensis (Meek and Worthen).
Nereidavus varians Grinnell.

CRUSTACEA.

Aparchites minutissimus (Hall).
Asaphus gigas DeKay.
" maximus Locke.
Bollia persulcata Ulrich. (c)
Bythocypris cylindrica (Hall).
Calymmene callicephala Green. (c)
Ulrichia nodosa (Ulrich). (c)

POSITION UNCERTAIN.

Arthraria biclavata Miller.
Bythotrephis gracilis Hall.
" gracilis-crassa Hall.
Pasceolus globosus Billings.
Rusophycus bilobatum Vanuxem.

Lower Richmond Fauna.

In addition to the species in the foregoing list, the following occur in the lower Richmond:

SPONGIÆ.

Brachiospongia tuberculata James.
Dystactospongia minima Ulrich.
Hindia sphæroidalis-parva Ulrich.

CŒLENTERATA.

Calopœcia cribriformis Nicholson.
Columnaria alveolata Goldfuss.
" halli Nicholson.
Labechia ohioensis (Nicholson).
Megalograptus welchi Miller.

ECHINODERMATA.

Compsocrinus harrisi (Miller).
" miamiensis (Miller).
Cyclocystoides magnus Miller and Dyer.
Cyclocystoides minus Miller and Dyer.
Cyclocystoides mundulus Miller and Dyer.
Cyclocystoides parvus Miller and Dyer.
Dendrocrinus caduceus (Hall).
" casei Meek.
" erraticus Miller.
Gaurocrinus cognatus (Miller).
" magnificus Miller.
" nealli (Hall).
Glyptocrinus? fornshelli Miller.
" richardsoni Wetherby.
Heterocrinus juvenis Hall.
Lichenocrinus affinis Miller.
Ohiocrinus oehanus (Ulrich).
Palæaster exculptus Miller.
" harrisi Miller.
" longibrachiatus Miller.
" magnificus Miller.
" miamiensis Miller.
" simplex Miller.
Palæasterina approximata Miller and Dyer.
Palæasterina speciosa Miller and Dyer.
Rhaphanocrinus sculptus (Miller).
Streptaster? septembrachiatus (Miller and Dyer).
Tanaocrinus typus Wachsmuth and Springer.
Tæniaster elegans Miller.
" miamiensis (Miller).
Urasterella grandis (Meek).
Xenocrinus baeri (Meek).
" penicillus Miller.

BRYOZOA.

Amplexopora pustulosa Ulrich.
Arthropora shafferi (Meek), variety.
Atactopora sp.
Atactoporella schucherti Ulrich.
Batostoma varians (James). (c)
Berenicea primitiva Ulrich.
Bythopora delicatula (James). (c)
" meeki (James). (c)
Callopora subnodosa Ulrich.
" sp.
Calloporella circularis (James).
Ceramoporella granulosa Ulrich, variety.
Ceramoporella ohioensis (Nicholson).
Ceramoporella whitei (James).
" sp.
Constellaria limitaris Ulrich.
Eridotrypa simulatrix Ulrich.
Graptodictya perelegans (Ulrich).
Helopora elegans, Ulrich.
" harrisi James.
Heterotrypa subramosa (Ulrich).
Heterotrypa subramosa - prolifica Ulrich.
Homotrypa dawsoni (Nicholson).
" wortheni (James). (c)
" several undescribed species.
Homotrypella sp.
Lioclemella subfusiformis (James)
Monticulipora sp.
Nicholsonella sp.
Pachydictya fenestelliformis (Nicholson).

Paleschara beani (James).
Proboscina frondosa (Nicholson).
Ptilodictya flagellum Nicholson.
" nodosa James.
Rhinidictya lata (Ulrich).
Rhopalonaria venosa Ulrich.
Spatiopora corticans (Nicholson).
" montifera Ulrich.
" tuberculata (Edwards and Haime).
Spatiopora sp.

BRACHIOPODA.

Catazyga headi (Billings).
Dalmanella jugosa James.
Dinorthis scovillei (Miller).
Hebertella insculpta Hall.
Lingula vanhorni Miller.
Platystrophia cypha (James).
Rafinesquina alternata-alternistriata (Hall).
Rhynchotrema capax-perlamellosum (Whitfield).
Strophomena neglecta James.
" nutans Meek.
" subtenta Conrad.
" sulcata (Verneuil).
" vetusta (James).
Trematis quincuncialis Miller and Dyer.

PELECYPODA.

Anomalodonta alata Meek.
" costata James.
" gigantea Miller.
Byssonychia cultrata Ulrich.
" grandis Ulrich.
Corallidomus concentricus Whitfield.
Ctenodonta albertina Ulrich.
" iphigenia Billings.
" similis Ulrich.
Cuneamya curta Whitfield.
" miamiensis Hall and Whitfield.
Cuneamya neglecta Meek.
" scapha Hall and Whitfield.
Cymatonota attenuata Ulrich.
" semistriata Ulrich.
" typicalis Ulrich.
Eridonychia crenata Ulrich.
Lyrodesma major (Ulrich).
Modiolopsis concentrica Hall and Whitfield.
Modiolopsis pholadiformis Hall.
" versaillesensis Miller.
Opisthoptera alternata Ulrich.
Opisthoptera extenuata Ulrich.
" fissicosta Meek.
" laticostata Ulrich.
Orthodesma contractum (Hall).
" curvatum Hall and Whitfield.
Orthodesma cymbula Miller and Faber.
Orthodesma rectum Hall and Whitfield.
Orthodontiscus milleri (Meek).
Psiloconcha elliptica Ulrich.
" grandis Ulrich.
" subrecta Ulrich.
Pterinea corrugata (James).
" subquadrata James.
" welchi James.
Sedgwickia? divaricata Hall and Whitfield.
Sedgwickia? lunulata Whitfield.
Whitella carinata (Meek).
" obliquata Ulrich.
" ohioensis Ulrich.
" quadrangularis (Whitfield).
" subovata Ulrich.
" umbonata Ulrich.

GASTROPODA.

Archinacella rugatina Ulrich.
Conradella dyeri (Hall),
Cyclonema bilix-conicum Miller.
Cyrtolites ornatus Conrad.
Helcionopsis striata Ulrich.
Lophospira perlamellosa Ulrich.
Plethospira striata Ulrich.
Protowarthia morrowensis (Miller and Dyer).
Protowarthia subcompressa Ulrich.
Trochonema madisonense Ulrich.

CEPHALOPODA.

Cyrtoceras faberi James.
" irregulare Wetherby.
Gomphoceras indianense Miller and Faber.
Orthoceras carleyi Hall and Whitfield.
Orthoceras fosteri Miller.
" hallanum Miller.
Trocholites circularis Miller and Dyer.

VERMES.

Spirorbis cincinnatiensis Miller and Dyer.

CRUSTACEA.

Acidaspis onealli Miller.
Beyrichia parallela Ulrich.
Bollia pumila Ulrich.
" regularis (Emmons).
Ceratopsis chambersi-robusta Ulrich.
Ceraurus meekanus Miller.
Dalmanites breviceps Hall.
Drepanella richardsoni (Miller).
Lichas harrisi Miller.
Primitia glabra Ulrich.
" milleri Ulrich.
Tetradella lunatifera Ulrich.
" quadrilirata Hall and Whitfield.
Tetradella quadrilirata-simplex Ulrich.

POSITION UNCERTAIN.

Faberia anomala Miller.
Trichophycus lanosum Miller and Dyer.

Middle Richmond Fauna.

In addition to the species previously given as ranging through the Richmond, the following occur in these beds:

SPONGIÆ.

Streptospongia labyrinthica Ulrich.

CŒLENTERATA.

Streptelasma divaricans (Nicholson).
Tetradium minus Safford, variety.

ECHINODERMATA.

Dendrocrinus polydactylus (Shumard).
Lepadocrinus moorei (Meek).
Lepidodiscus faberi (Miller).
Lichenocrinus tuberculatus Miller.

BRYOZOA.

Batostoma sp.
Crepipora sp.
Heterotrypa affinis Ulrich.
Homotrypa wortheni (James).
" several undescribed species.
Homotrypella sp.
Leptotrypa stidhami Ulrich.
Lioclemella annulifera (Whitfield).
Mesotrypa patella (Ulrich).
Monticulipora lævis Ulrich.
" lævis - consimilis Ulrich.
Monticulipora parasitica Ulrich.
" sp.
Ptilodictya magnifica Miller.
" plumaria James.

BRACHIOPODA.

Dinorthis subquadrata Hall.
Leptæna rhomboidalis (Wilckens).
Platystrophia acutilirata (Conrad). (c)
Rhynchotrema dentatum (Hall). (c)
Strophomena rugosa Blainville.

PELECYPODA.

Anoptera miseneri Ulrich.
Byssonychia obesa Ulrich.
" richmondensis Ulrich.
" robusta (Miller).
" subrecta Ulrich.
" tenuistriata Ulrich.
Clionychia excavata Ulrich.
Ctenodonta hilli (Miller).
Cyrtodonta cuneata (Miller).
" halli Nettleroth.
Ischyrodonta decipiens Ulrich.
" elongata Ulrich.
Ischyrodonta miseneri Ulrich.
" modioliformis Ulrich.
" ovalis Ulrich.
" truncata Ulrich.
Opisthoptera obliqua Ulrich.
Orthodesma subangulatum Ulrich.
Modiolodon declivis Ulrich.
" subrectus Ulrich.
Rhytimya byrnesi (Miller).
Sphenolium cuneiforme (Miller).
" richmondense Miller.

GASTROPODA.

Archinacella indianensis (Miller).
" richmondensis Ulrich.
Bellerophon mohri Miller.
" subangularis Ulrich.
Bucania crassa Ulrich.
" gorbyi (Miller).
" simulatrix Ulrich.
Helicotoma marginata Ulrich.
Lophospira acuminata Ulrich.
" ampla Ulrich.
Oxydiscus magnus (Miller).
Raphistoma richmondense Ulrich.
Salpingostoma richmondense Ulrich.
Tentaculites richmondensis Miller

CEPHALOPODA.

Cyrtoceras amœnum Miller.
" lysander Billings.
Gomphoceras eos Hall and Whitfield.
Gyroceras baeri (Meek and Worthen).

POSITION UNCERTAIN.

Solenopora compacta (Billings).
Strephochetus richmondensis Miller.

Upper Richmond Fauna.

Almost nothing is known as yet of these beds, their thickness, distribution, and fossil contents. The list here given is, therefore, probably, very incomplete. Some of the forms given in the list of those ranging through the Richmond occur in these beds, but perhaps not all given in that list. Some of those in the following list may belong to lower beds:

SPONGIÆ.

Heterospongia aspera Ulrich.
" knotti Ulrich.
Heterospongia subramosa Ulrich.

CŒLENTERATA.

Beatricea nodulosa Billings.
" undulata Billings.
Columnaria alveolata Goldfuss.
Labechia montifera Ulrich.
" ohioensis Nicholson.

BRACHIOPODA.

Zygospira kentuckyensis James.

PELECYPODA.

Ctenodonta cingulata (Ulrich).
Opisthoptera casei (Meek and Worthen).

GASTROPODA.

Lophospira ampla Ulrich.

CEPHALOPODA.

Cyrtocerina madisonensis Miller.

CRUSTACEA.

Entomis madisonensis Ulrich.
Eurychilina striatomarginata (Miller).
Isochilina subnodosa Ulrich, variety.
Jonesella digitata Ulrich.
Leperditia cæcigena Miller.
Primitia medialis Ulrich.

3. LIST OF LOCALITIES.

For the convenience of students and collectors a list is here given of exposures in the city of Cincinnati, and immediate vicinity, where the various beds may be studied and their fossils collected. The list is not exhaustive. Other exposures of greater or less extent may be found. Grading and other improvements are continually affording new exposures, but from becoming overgrown and other causes, dumps, and even cuts are in a few years spoiled for geological purposes. All the strata have been exposed at one time or another, but not all are now exposed. The list given must be regarded, at best, as but temporary. On the map (Plate I), the location of these exposures has been indicated, the abbreviations being placed as nearly as possible upon the exact locations. The map is a partial reproduction of a part of the Cincinnati sheet of the Topographic Map of the U. S. Geological Survey.

TRENTON PERIOD.

The principal exposures are on the south bank of the Ohio from West Covington to Ludlow; at the mouth of the Licking River (Covington side); two outcrops on the west bank of the Licking River in Covington; several small streams flowing into the Licking south of Newport and Covington, cut into the Trenton as well as afford exposures of the lower Utica strata; dèbris from Trenton strata has been thrown out in excavating the new water-works tunnels; the south bank of the Ohio River in the vicinity of Fort Thomas shows the Trenton outcropping; several quarries, now abandoned, on the road between New Richmond and Point Pleasant, in Clermont County, Ohio, have been opened in Trenton strata.

CINCINNATI PERIOD.

Utica Group.

Lower Utica.—The lowest strata of the Utica may be found in the north bank of the Ohio in the First Ward (Fulton), and in the south bank of the Ohio overlying the Trenton

between West Covington and Ludlow, but the exposures are seldom satisfactory; the same strata may be seen overlying the Trenton in the Ohio River bank near Fort Thomas. Strata somewhat higher have been cut into along the line of the Ludlow cars in West Covington, where the car line leaves the river bank; also in a grading two or three blocks south from the old "Post & Co. factory," on the south bank of the Ohio, near Ludlow. The strata overlying these may be seen in a creek south of Lexington Pike, shortly after leaving Covington, near the "elbow;" probably, also, in other streams, but the fossils can seldom be had without "digging" for them. Many of the more delicate forms can be obtained in no other way.

Middle Utica.—The middle and upper Utica are exposed along the line of the Elberon Avenue cars in Sedamsville; in Fairmount, on Shadwell Street, one block south of Westwood Avenue; in West Fork and its branches, west of Cumminsville; in Economy or West Covington, a block or two distant from the line of the Ludlow cars; at Cote Brilliante, in the southeastern part of Newport, Kentucky; at two or three points along the line of the Monmouth cars south of Newport; and at several points along the line of the Fort Thomas cars.

Upper Utica.—Abuts on Clifton Avenue, under the Elm-Street Incline Plane; across the valley, north from Dixmyth Avenue, in West Clifton, is a good exposure; occasional exposures also occur at other points in Clifton; West Fork and some of its branches, west of Cumminsville, expose the upper Utica; also the hillsides south of Newport and Covington show these strata at several places.

Lorraine Group.

Mt. Hope Beds.—The best exposures known to the writer are near Mt. Hope Road, on the southeastern slope of Price Hill, and on Mitchell Avenue, in Avondale, near Rose Hill Park. They may also be seen on Clifton Avenue, near the Elm-Street Incline Plane, and in the quarry on the hill nearest the Licking, immediately south of Newport.

Fairmount Beds.—These are the beds usually opened in quarries. The fossils are generally obtained by hunting over the "dumps." Quarries are found on Price Hill near Elberon Avenue, and near Mt. Hope Road; in Fairmount; in North Fairmount; on Robert Avenue, Westwood; on the north side of Fairview hill; on Clifton Avenue opposite Burnet Woods Park; on Madison Avenue, Walnut Hills; on the east side of Reading Road or Hunt Street, south of McMillan Street; on the hillsides south of Newport and Covington; near St. Johns Park; on the hillside east of Madisonville.

Bellevue Beds.—These strata may be seen projecting near the top of the hill at the Fairview Incline Plane; near the top of the bluff on Clifton Avenue, just north of the bend, not far from the Elm-Street Incline Plane; on Clifton Avenue opposite Burnet Woods Park; and on Francisco Street in Walnut Hills.

Corryville Beds.—Small exposures are found at several places on Price Hill; a number of exposures may be seen on Fairview Heights, within two or three blocks of the Fairview Incline Plane; also on the north side of McMillan Street, east of Fairview Avenue; and on McMillan Street east of Reading Road.

Mt. Auburn Beds.—The street just east of the Water Tanks on Price Hill (Grand Avenue) has been cut through these beds; they are also exposed at and near the corner of Calhoun Street and Clifton Avenue.

Warren Beds.—These beds are not exposed at or near Cincinnati. Streams in the vicinity of Lebanon and Oregonia, Ohio, afford typical exposures.

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1898.— Fowke, Gerard. Pre-glacial Drainage in the Vicinity of Cincinnati; its relation to the origin of the modern Ohio River, and its bearing upon the question of the southern limits of the ice-sheet. (Bull. Sci. Lab. Denison Univ., XI, 1898, pp. 1–10.)

1900.— Fowke, Gerard. Pre-glacial Drainage Conditions in the Vicinity of Cincinnati, Ohio. (Ohio State Academy of Science, Special Papers, No. 3, 1900, pp. 68–75.)

1901.—Cumings, Edgar R. A Section of the Upper Ordovician at Vevay, Indiana. (American Geologist, XXVIII, 1901, pp. 361–381, pls. xxxiv, xxxv.)

1898.— United States Geological Survey. Topographic Map. East and West Cincinnati Quadrangles. Surveyed in 1898. Contour interval, 20 feet.

Catalogues of Cincinnati Fossils.

1871.—James, U. P. Catalogue of the Lower Silurian Fossils, Cincinnati Group, found at Cincinnati and vicinity — within a range of forty or fifty miles. Cincinnati, 1871. 14pp. Second Edition, April, 1875. 8pp. Supplement, July 10, 1879, in Paleontologist, No. 4, 1879, pp. 29–32.

1873.— Orton, Edward. Catalogue of the Described Fossils of the Cincinnati Group as shown in southwestern Ohio. (Rep. Geol. Sur. Ohio, I, 1873, pp. 400–411.)

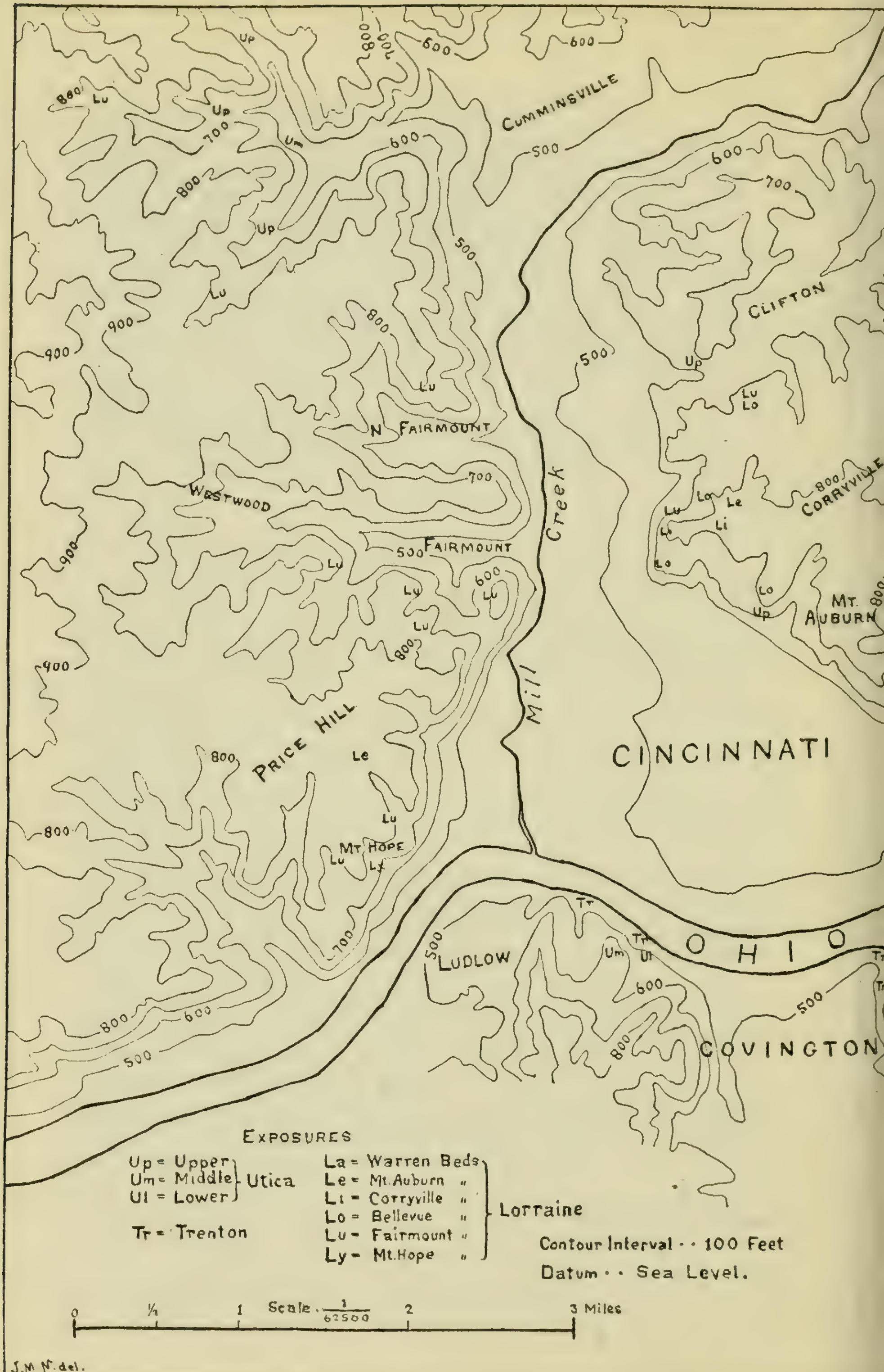
1878.— Mickleborough, John, and Wetherby, A. G. A Classified List of Lower Silurian Fossils, Cincinnati Group. (Jour Cincinnati Soc. Nat. Hist., I, 1878, pp. 61–86.)

1879.— Miller, S. A. Catalogue of Fossils found in the Hudson River, Utica Slate, and Trenton Groups, as exposed in the southeast part of Indiana, southwest part of Ohio, and northern part of Kentucky. (Eighth-Ninth-Tenth Ann. Reports [one volume] Geol. Sur. Indiana, 1879, pp. 22–56.)

1880.— Ulrich, E. O. Catalogue of Fossils occurring in the Cincinnati Group of Ohio, Indiana, and Kentucky. Cincinnati, 1880. 31pp.

1881.—James, Joseph F. Catalogue of the Fossils of the Cincinnati Group. Cincinnati, 1881. 27pp.

1896.— Harper, G. W., and Bassler, R. S. Catalogue of the Fossils of the Trenton and Cincinnati Periods, occurring in the vicinity of Cincinnati, Ohio. Cincinnati, 1896. 34pp.


Cumminsville
Clifton
N Fairmount
Westwood
Fairmount
Corryville
Mt. Auburn
Price Hill
Mt. Hope
Mill Creek
Cincinnati
Ludlow
Ohio
Covington
Exposures
Up = Upper
Um = Middle
Ul = Lower
Utica
Tr = Trenton
La = Warren Beds
Le = Mt. Auburn "
Li = Corryville "
Lo = Bellevue "
Lu = Fairmount "
Ly = Mt. Hope "
Lorraine
Contour Interval · · 100 Feet
Datum · · Sea Level.
Scale $\frac{1}{62500}$
0 ½ 1 2 3 Miles
J.M N. del.


ST. BERNARD
NORWOOD
AVONDALE
IDLEWILD
WALNUT
HILLS
RIVER
NEWPORT
Little Miami River
FORT THOMAS
River

ARTICLE IV.—DESCRIPTION OF A NEW BRYOZOAN, "HOMOTRYPA BASSLERI" n. sp., FROM THE WARREN BEDS OF THE LORRAINE GROUP.

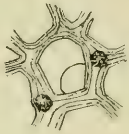
By John M. Nickles.

Homotrypa bassleri n. sp.

Zoarium dwarfish in habit of growth, consisting of flattened, branching fronds, which have gradually expanded from almost cylindrical stems without increasing any in thickness. No specimens showing basal portion or mode of attachment have been observed. Branches usually given off in the same plane as the frond, oftenest by bifurcation, though they are sometimes given off from the side. Examples used in preparing this description, none of them complete, vary from 15 to 32 mm. in height, from 5 to 9 mm. in width, and are about 3 mm. in thickness. Surface studded with low, rounded monticules, a little over one mm. in diameter, and from one to two mm. apart; rarely the monticules are almost obsolete. Apertures rather small, 9 or 10 in 2 mm., subcircular or subangular, often a little oblique to the surface; on the monticules the apertures, as is commonly the case, are a trifle larger than the others. In the axial region the zoœcia have very thin walls, rather less flexuous and crinkled than is the rule in this genus; the zoœcia bend rather abruptly to the peripheral region, where they have their walls much thickened; after making the turn they proceed at right angles to the surface in some specimens, in others a little obliquely. No diaphragms developed in the axial region and but very few in the mature region. Cystiphragms line the upper side of the zoœcia in a single row in the peripheral region, their walls attenuating toward the back, indicating that in the living state calcification was more or less incomplete. The arrangement of the layers forming the walls is well shown in the enlarged view of a tangential section of a single cell, Figure 5, which shows also the appearance of the cystiphragms when cut across, and the structure of the

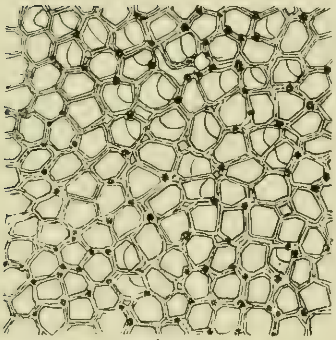
acanthopores. Acanthopores about twice as numerous as the cells, not conspicuous; few specimens show them on the surface. A small number of irregular, angular interspaces simulating mesopores are seen in tangential sections and also on the surface.

1

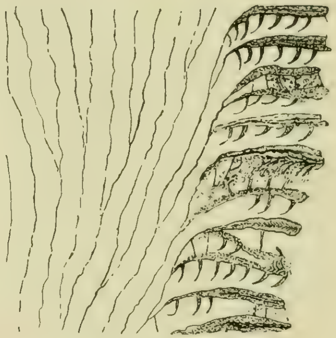


5

2



4



3

Figures 1 and 2.— Natural size views of two rather large examples, neither complete. Figure 3.— Portion of a vertical section, $\times$ 20. Figure 4.— Portion of a tangential section, $\times$ 20. Figure 5.— A tangential section of a single zoœcium, showing wall structure and structure of acanthopores, $\times$ 40.

This species is so readily distinguished by its small, dwarfish, flattened growth, tuberculated surface and small apertures from all bryozoa found associated in the same beds, and from other species of the genus hitherto described, that detailed comparison seems unnecessary. It belongs to a section of the genus *Homotrypa*, which attains a wide development in the Richmond group.

It seems a little singular that the genus *Homotrypa*, while well represented in the various groups of the Trenton period, is practically lacking in the Utica and sparingly developed in the Lorraine, with from one to three characteristic species in each of its divisions, except the lowest; in the Richmond the genus becomes very prolific in species. A very large number of new species, principally from the Richmond, are known that await description.

This species was discovered by the writer while collecting fossils in company with Messrs. E. O. Ulrich and R. S. Bassler, in June, 1899, in the vicinity of Oregonia and Lebanon, Ohio. It was at this time, also, that it was recognized that these beds form the highest division of the Lorraine. While not ranging entirely through the Warren beds of the Lorraine group, this species is one of the most characteristic fossils of these beds, and is restricted to them.

The specific name is given in honor of my esteemed friend and former co-worker, Mr. R. S. Bassler, now of the U. S. National Museum.

Formation and locality: A common and characteristic species of the Warren beds which form the uppermost division of the Lorraine group of the Cincinnati period. The specimens studied were collected in the vicinity of Lebanon, Ohio; and near Oregonia, Ohio.

ADDITIONS AND CORRECTIONS.

Page 4, add: *Clivina analis* Putz.
" 7, " *Dicœlus ambiguus* Laf.
" 11, " (HYDROPHILIDÆ) *Hydræna pennsylvanica* Kies.
" 13, " *Ptomaphagus oblitus* Lec.
" 18, leave out: Microcyptus testaceus.
" 19, add: *Oxyporus quinquemaculatus* Lec.
" 19, " *Lispinus exiguus* Er.
" 20, for Photinus read: *Protinus*.
" 20, add: (TRICHOPTERYGIDÆ) *Limulodes paradoxus* Matth.
" 21, " (PHALACRIDÆ) *Phalacrus politus* Melsh.
" 22, line 2, for noveninotata read: *novemnotata*.
" 22, line 12, for bivulneratus read: *bivulnerus*.
" 22, add: (ENDOMYCHIDÆ) *Mycetæa hirta* Marsh.
" 23, line 18, for bivittatus Gerst, read: *biguttatus* Say.
" 26, add: *Ino reclusa* Lec.
" 27, " *Dermestes caninus* Germ.
" 27, " *Byturus unicolor* Say.
" 28, " *Cryptorhopalum triste* Lec.
" 29, " *Saprinus lugens* Er.
" 29, for AULETES read ÆLETES, and add: *Æ. politus* Lec.
" 30, add: *Brachypterus urticæ* Fab.
" 31, " (TROGOSITIDÆ) *Lycoptus villosus* Csy.
" 32, " *Limnichus punctatus* Lec.
" 33, " (PARNIDÆ) *Psephenus lecontei* Lec.
Lutrochus luteus Lec.
Dryops lithophilus Germ.
D. fastigiatus Say.
Stenelmis linearis Zimm.
S. bicarinatus Lec.
S. crenatus Say.

Page 36, add: *Elater sayi* Lec.
" 39, " *Actenodes mendax* Horn.
" 41, under *Pyractomena*, retain *P. angulata* and *lucifera*, and insert the genus *PHOTINUS*, comprising the species, *pyralis*, *marginellus*, and *scintillans*.
" 41, add: *Tytthonyx erythrocephalus* Fab.
" 45, " (PTINIDÆ) *Lasioderma serricorne* Fab.
" 45, leave out: Sinoxylon sextuberculatum.
" 46, for Sphindus denticollis, read: *Odontosphindus denticollis* Lec.
" 46, add: *Sphindus americanus* Lec.
" 46, " (LUCANIDÆ) *Ceruchus piceus* Web.
" 49, " *Aphodius vittatus* Say.
" 50, " *Cyclocephala immaculata* Oliv.
" 57, line 2, for submarginatus, read: *subarmatus*.
" 57, add: *Saperda candida* Fab.
" 58, " *Orsodacna atra* Ahr.
" 61, " *Diphaulaca bicolorata* Horn.
" 61, " *Haltica bimarginata* Say.
" 62, " *Chætocnema minutum** Melsh.
" 62, leave out: Longitarsus solidaginis Horn.
" 65, after description of Hypophlœus rugosus, add:

Prof. E. A. Schwarz, of the U. S. National Museum, suggests that this may be a form of *Lyphia ficicola* Mulsant, which has been taken at Washington, D. C., where it is said to have been introduced. My specimens occurred in numbers under the bark of old logs, in thick woods, several years in succession, and were evidently breeding, as they were in couples. L. ficicola is said to live in figs.

" 75, for AMNESIA, read: ANAMETIS.
" 79, last line, for angusta, read: *angustula*.
" 81, *Dryotribus mimeticus* is a maritime species. The specimen said to have been found here, may have been accidentally brought in with white sand from the Gulf coast.

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* In this, as in many other instances in the present paper, the termination of the specific name has been changed so as to conform to the grammatical gender of the generic name, even though contrary to established usage. For these changes the *Editor* of the Journal is, alone, responsible. (J. L.

ARTICLE V.—A REVISED LIST OF THE COLEOPTERA OBSERVED NEAR CINCINNATI, OHIO,

WITH NOTES ON LOCALITIES, BIBLIOGRAPHICAL REFERENCES, AND DESCRIPTION OF NEW SPECIES.

By Charles Dury.

In this journal, October, 1879, I published a list of the Coleoptera observed in the vicinity of Cincinnati, enumerating 1,419 species. In supplemental papers (1882) added 179 species. Long continued and more careful collecting has revealed many other, rare and interesting forms. Changes in environment that have taken place, have caused many species to become rare or disappear altogether, while some new to the locality have been introduced. Conspicuous among these are the destructive "clover root beetle" (*Phytonomus punctatus*) and the "pea green Diabrotica" (*Diabrotica longicornis*), etc. Some others that are perhaps beneficial have also made their appearance, among which may be mentioned the laıge showy "Lady bugs" *Coccinella* (*Neoharmonia*) *venusta* and *notulata.*

The area covered in making the collections, on which this list is based, is the same as that given in former list mentioned above. The twenty-three years that have elapsed since that publication has wrought great changes in the local collectors of Coleoptera, all, save one, having either gone to their last resting places or removed from the state. But few new workers in this interesting order have come into the field. Annette Braun, with mother and sister, have made a very fine collection of local insects and added some rare species to the fauna of the locality. Their well prepared material can not be surpassed. Our dear, old friend, Dr. Geo. H. Horn, of Philadelphia, died November 25, 1897. His loss was a calamity severely felt by students of North American Coleoptera. His many excellent papers and the thousands of specimens gratuitously determined by him for others, bear testimony to the vast amount of work done by this unassuming and talented gentleman. And all this accomplished in moments snatched from a busy professional life, actuated only by love of the science.

Four hundred and forty-eight of this list were originally described by Thos. Say, the pioneer entomologist who lived at New Harmony, Ind., the faunæ of Cincinnati and of that place being almost identical. I can not too strongly urge our young people to study the insects, or some other branch of Nature's creatures.

Her methods are so fascinating and wonderful. As I look back over the past thirty years, much of which time has been spent in fields and woods, it brings back only one regret, and that is, that I can not go over it all again. It has been one long round of health-giving pleasure. Our beautiful woodland, with its wealth of varied bird, insect and plant life, is a revelation to those whose eyes become trained to see and understand nature's beauties. During the warmer months the forest is alive with insects, all striving to accomplish the great purpose with which they are endowed, the perpetuation of the species. Many of them employing the most intelligent and cunning devices to accomplish this end.

In answer to the often repeated question "what books shall I get to help in a study of Coleoptera," I enumerate some of those which I have found most useful. The word "*Trans.*," often used, refers to the Transactions of the American Entomological Society of Philadelphia. Such papers as are not out of print can be furnished by the Academy of Natural Sciences, Philadelphia. Some general works that are very desirable to students are classification of the "Coleoptera of North America," and "Rhyncophora," by LeConte and Horn; Packard's "Guide to the Study of Insects;" Comstock's "Manual;" papers on North American Coleoptera, by Maj. Thos. L. Casey, published in annals of New York Academy of Sciences, and New York Entomological Soc.; "Fifth Annual Report of the Entomologist of Minn.," by our lamented friend Prof. Lugger (his reports on the other orders are very valuable also).

This list enumerates 64 families, 828 genera and 1,888 species, and describes 6 new ones.

CINCINDELIDÆ.

"Tiger Beetles."

TETRACHA.

T. virginica *Linn.*

CICINDELA.

C. unipunctata *Fab.*
C. sexguttata *Fab.*
C. purpurea *Oliv.*
C. formosa *Say.*
C. generosa *Dej.*
C. vulgaris *Say.*
C. repanda *Dej.*
C. hirticollis *Say.*
C. punctulata *Fab.*
C. cuprascens *Lec.*
C. marginipennis *Dej.*

C. purpurea was taken here years ago, and again recently. I never saw *Tetracha virginica* here, until 1899. June 28, 1900, they were flying and running about under the electric lights by

hundreds. Bull, Brooklyn Ent. Soc., 1883, p. 77, says of this species: "winged, but does not fly." It does fly nevertheless. They occur here from June to October 2.

C. marginipennis was never observed here until May 17, 1899, when about 25 were taken near Batavia Junction, on a sand bar of the Little Miami river.

C. cuprascens occurs on the sand bars of the Ohio river in vast numbers. *C. unipunctata* and *C. sexguttata* live in the woods. *C. generosa* and *C. formosa* occur in sand pits. *C. punctulata* occurs everywhere. Most of the others are found along sandy flats and banks of streams. They are very active, and a good net is required to effect their capture. For a Monograph of Cicindelidæ see Bulletin Brooklyn Entomological Soc., Nov., 1883, and Revision of the Cicindelidæ of Boreal America, by Chas. W. Leng, Trans. xxviii, 1902, p. 93. This exhaustive and complete paper just received. Every student should have a copy.

CARABIDÆ.

"Rapacious Ground Beetles."

OMOPHRON.

O. robustum *Horn.*
O. americanum *Dej.*
O. tessellatum *Say.*

The sandy shores of Mill Creek was the home of these curious little bettles; hundreds could be secured by throwing water over the sloping banks, when Omophron, with many other small beetles, would emerge and run up the banks, some of the Carabidæ and Heteroceridæ instantly taking flight. Omophron however do not fly and were easily captured. On July 10, 1878, I took 365, divided as follows, 180 *O. tessellatum,* 147 *O. robustum,* and 38 *O. americanum.* Then, Mill Creek was clean, with sandy banks and pebbly bottom. Now it has become a vile open sewer, the sand is saturated with sewage, which decays and gives off deadly gases, destroying all fish and insect life. For synoptic table of Omophron see Bull, Brooklyn Ent. Soc., 1878, p. 71.

CYCHRUS.

C. stenostomus *Web.*
C. lecontei *Dej.*
C. canadensis *Chd.*
C. elevatus var. heros *Harr.*
C. andrewsii *Bland.*

All Cychrus have become rare here. I have not seen *C. andrewsii* or *C. heros* for years. C. heros, when living is one of the most beautiful of the genus, its rich, purple color and graceful form renders it very conspicuous. We trapped many *C. heros* by placing flat stones along the edge of woods, finding the beetles concealed beneath.

CARABUS.

C. limbatus *Say.*
C. vinctus *Web.*

CALOSOMA.

C. externum *Say.*
C. scrutator *Fab.*
C. wilcoxi *Lec.*
C. sayii *Dej.*
C. calidum *Fab.*

C. sayii is rare here, the others common. The electric lights attract great numbers of these useful beetles, many of which are crushed and otherwise destroyed. During May, 1902, *C. scrutator* was abundant, feeding on "canker worms."

ELAPHRUS.

E. ruscarius *Linn.*

Found about wet places, where it runs over the moist ground.

NOTIOPHILUS.

N. semistriatus *Say.*
N. sibericus *Mots.*

Notiophilus lives under moist decaying leaves. Alongside of an old barn I took hundreds of these active beetles. They were concealed under rubbish and fallen grass.

NEBRIA.

N. pallipes *Say.*

PASIMACHUS.

P. elongatus *Lec.*
P. punctulatus *Hald.*

SCARITES.

S. subterraneus *Fab.*

DYSCHIRIUS.

D. hæmorrhoidalis *Dej.*
D. longulus *Lec.*
D. globulosus *Say.*
D. sphæricollis *Say.*
D. erythrocerus *Lec.*
D. brevispinus *Lec.*
D. hispidus *Lec.*

Dyschirius are abundant, if looked for along the sandy shores of streams and will come out when water is thrown over the sand.

CLIVINA.

C. dentipes *Dej.*
C. impressifrons *Lec.*
C. collaris *Hbst.*
C. bipunctata *Fabr.*
C. postica *Lec.*
C. rubicunda *Lec.*

SCHIZOGENIUS.

S. lineolatus *Say.*
S. ferrugineus *Putz.*

ARDISTOMIS.

A. viridis *Say*. A. puncticollis *Putz*.

The last three genera, like Dyschirius, can be found abundantly along the shores of rivers and creeks.

PANAGÆUS.

P. crucigerus *Say*. P. fasciatus *Say*.

Both species were always rare here. Have taken them hiding under drift-wood on bank of Ohio river.

BEMBIDIUM.

B. lævigatum *Say*.
B. inæquale *Say*.
B. punctatostriatum *Say*.
B. coxendix *Say*.
B. confusum *Hayward*.
B. americanum *Dej*.
B. honestum *Say*.
B. chalceum *Dej*.
B. nigrum *Say*.
B. picipes *Kby*.
B. cordatum *Lec*.
B. dorsale *Say*.
B. variegatum *Say*.
B. intermedium *Kby*.
B. versicolor *Lec*.
B. quadrimaculatum *Linn*.
B. affine *Say*.

The Bembidium are abundant along the shores of streams. They are active little things, running rapidly when disturbed, quickly hiding under stones or in cracks in the ground. The species are rather difficult to separate unless named types are available for comparison. The latest paper on the genus is one by Roland Hayward: Trans. Amer. Ent. Soc., vol. XXIV, p. 4.

ANILLUS.

A. fortis *Horn*.

I have only taken a single specimen of this minute, pale, eyeless carabid. It was under a flat stone, where a colony of pale ants had their nest. A cluster of *Microcyptus testaceus* were also present in the nest.

TACHYS.

T. scitulus *Lec*.
T. nanus *Gyll*.
T. flavicaudus *Say*.
T. tripunctatus *Say*.
T. ferrugineus *Dej*.
T. granarius *Dej*.
T. lævis *Say*.
T. incurvus *Say*.
T. vivax *Lec*.
T. xanthopus *Dej*.
T. dolosus *Lec*.

Tachys are found in various places, under bark, in decaying wood, along the shores of streams, etc. *T. laevis* is the smallest carabid I have taken here, being only 2.75 mm. long. The latest paper on the genus is by R. Hayward: Trans. Amer. Ent. Soc., vol. XXVI, p. 191.

PERICOMPSUS.

P. sellatus *Lec.*

PATROBUS.

P. longicornis *Say.*

ZUPHIUM.

Z. americanum *Dej.*

TETRAGONODERUS.

T. fasciatus *Hald.*

LEBIA.

L. grandis *Hentz.*
L. atriventris *Say.*
L. pulchella *Dej.*
L. viridis *Say.*
L. pumila *Dej.*
L. viridipennis *Dej.*
L. lobulata *Lec.*
L. ornata *Say.*
L. analis *Dej.*
L. fuscata *Dej.*
L. abdominalis *Chd.*
L. scapularis *Dej.*
L. vittata *Fab.*

COPTODERA.

C. ærata *Dej.*

This species is always found under the loose bark of trees and not beaten from vegetation as are many of the Lebia.

DROMIUS.

D. piceus *Dej.*
D. quadricollis *Lec.*

BLECHRUS.

B. pusio *Lec.*

CALLIDA.

C. punctata *Lec.*

PLOCHIONUS.

P. timidus *Hald.*

MYAS.

M. coracinus *Say.*
M. cyanescens *Dej.*

I never found either of these pretty blue species abundantly, of the first about eight, and the second only one, in over twenty-five years collecting.

PTEROSTICHUS.

P. adoxus *Say.*
P. obsoletus *Say.*
P. honestus *Say.*
P. obscurus *Say.*
P. femoralis *Kby.*
P. rostratus *Newm.*
P. stygicus *Say.*
P. permundus *Say.*
P. sayii *Brulle.*
P. tartaricus *Say.*

P. lacrymosus *Newm.*
P. coracinus *Newm.*
P. lucublandus *Say.*
P. mutus *Say.*

The species of *Pterostichus* are quite difficult to separate. This is particularly the case with the black species, where the series is large. For a synopsis of the genus see Bull, Brooklyn Ent. Soc., 1882, vol. v.

EVARTHRUS.

E. seximpressus *Lec.*
E. sigillatus *Say.*
E. americanus *Dej.*
E. acutus *Lec.*
E. sodalis *Lec.*
E. furtivus *Lec.*

AMARA.

A. avida *Say.*
A. furtiva *Say.*
A. exarata *Dej.*
A. angustata *Say.*
A. impuncticollis *Say.*
A. cupreolata *Putz*
A. fallax *Lec.*
A. polita *Lec.*
A. interstitialis *Dej.*
A. terrestris *Lec.*
A. musculus *Say.*

To identify the species of *Amara* see synoptic table by Horn: Trans., 1875, vol. v, p. 127-8. They are a difficult group.

LOXANDRUS.

L. erraticus *Dej.*
L. minor *Chd.*

Loxandrus, for some unknown reason, is exceedingly rare here. I have only taken three or four specimens in many years. When fresh, some of the species have a beautiful "mother of pearl" iridescence.

DICÆLUS.

D. dilatatus *Say.*
D. purpuratus *Bon.*
D. sculptilis *Say.*
D. furvus *Dej.*
D. ovalis *Lec.*
D. elongatus *Bon.*
D. teter *Bon.*
D. politus *Dej.*

Dicælus are large and common beetles, easily separated. See synoptic table by Horn: Bull. Brooklyn Ent. Soc., 1880, vol. III, pp. 51-52.

CALATHUS.

C. gregarius *Say.*
C. opaculus *Lec.*

PLATYNUS.

P. caudatus *Lec.*
P. hypolithus *Say.*
P. sinuatus *Dej.*
P. extensicollis *Say.*
P. viridis *Lec.*
P. ferreus *Hald.*
P. melanarius *Dej.*
P. crenistriatus *Lec.*
P. rubripes *Zimm.*
P. punctiformis *Say.*
P. ruficornis *Lec.*
P. octopunctatus *Fab.*
P. placidus *Say.*
P. excavatus *Dej.*

P. atratus *Lec.*
P. variolatus *Lec.*
P. obsoletus *Say.*
P. æruginosus *Dej.*

The *Platynus* are more or less abundant, except *P. caudatus.* Of this odd looking species, only one specimen has ever been taken here, and that was found by Dr. J. M. Crawford on the shore of a creek, under a stone.

OLISTHOPUS.

O. parmatus *Say.*

PERIGONA.

P. nigriceps *Dej.*

EUPHORTICUS.

E. pubescens *Dej.*

ATRANUS.

A. pubescens *Dej.*

LEPTOTRACHELUS.

L. dorsalis *Fab.*

CASNONIA.

C. pennsylvanica *Linn.*

GALERITA.

G. janus *Fab.*
G. bicolor *Drury.*

PINACODERA.

P. limbata *Dej.*

CYMINDIS.

C. americana *Dej.*
C. pilosa *Say.*

APENES.

A. lucidula *Dej.*
A. sinuata *Say.*

HELLUOMORPHA.

H. præusta *Dej.*
H. bicolor *Harr.*

BRACHYNUS.

B. americanus *Lec.*
B. perplexus *Dej.*
B. fumans *Fab.*
B. cordicollis *Dej.*

CHLÆNIUS.

C. erythropus *Germ.*
C. sericeus *Forst.*
C. diffinis *Chd.*
C. prasinus *Dej.*
C. leucoscelis *Cher.*
C. nemoralis *Say.*
C. tricolor *Dej.*
C. brevilabris *Lec.*
C. pennsylvanicus *Say.*
C. impunctifrons *Say.*
C. tomentosus *Say.*

ANOMOGLOSSUS.

A. emarginatus *Say*. A. pusillus *Say*.

BRACHYLOBUS.

B. lithophilus *Say*.

OODES.

O. cupreus *Chd*. O. 14 striatus *Chd*.

GEOPINUS.

G. incrassatus *Dej*.

This species burrows deeply in the sand, where it lives. I have trapped them by laying a flat board on the sand, and in wet weather they come to the surface, and hide under the board.

CRATACANTHUS.

C. dubius *Beauv*.

AGONODERUS.

A. lineola *Fab*.
A. infuscatus *Dej*.
A. pallipes *Fab*.
A. partiarius *Say*.
A. indistinctus *Dej*.
A. testaceus *Dej*.

HARPALUS.

H. dichrous *Dej*.
H. vulpeculus *Say*.
H. caliginosus *Fab*.
H. erraticus *Say*.
H. pennsylvanicus *De G*.
H. longior *Kby*.
H. faunus *Say*.
H. herbivagus *Say*.
H. nitidulus *Chd*.
H. gravis *Lec*.
H. testaceus *Lec*.

During nights of August 6 and 7, 1890, swarms of *H. caliginosus* came into Cincinnati, attracted by the electric lights. The streets and sidewalks were covered in places with their crushed remains.

SELENOPHORUS.

S. gagatinus *Dej*. S. conjunctus *Say*.

STENOLOPHUS.

S. ochropezus *Say*.

BRADYCELLUS.

B. rupestris *Say*.

TACHYCELLUS.

T. atrimedius *Say*. T. badiipennis *Hald*.

ANISODACTYLUS.

A. interstitialis *Say*.
A. rusticus *Dej*.
A. carbonarius *Say*.
A. baltimorensis *Say*.
A. piceus *Men*.
A. terminatus *Say*.

A. agricola *Say.*
A. harrisii *Lec.*
A. discoideus *Dej.*
A. nitidipennis *Lec.*
A. lugubris *Dej.*
A. sericeus *Harr.*

Synoptic tables of many of the families of CARABIDÆ can be found in Bulletin of the Brooklyn Ent. Soc. from 1879 to 1882.

HALIPLIDÆ.

"Crawling Water Beetles."

HALIPLUS.

H. punctatus *Aube.*
H. ruficollis *De G.*

CNEMIDOTUS.

C. simplex *Lec.*
C. duodecimpunctatus *Say.*
C. edentulus *Lec.*

These little beetles crawl about over aquatic plants, the bottom of ponds and creeks. They are not nearly as active as the following families. All of the aquatic beetles can be captured by dredging with a strongly made wire net, with small mesh.

DYTISCIDÆ.

HYDROCANTHUS.

H. iricolor *Say.*

LACCOPHILUS.

L. maculosus *Germ.*
L. proximus *Say.*
L. fasciatus *Aube.*

HYDROVATUS.

H. cuspidatus *Germ.*

BIDESSUS.

B. affinis *Say.*
B. lacustris *Say.*
B. undescribed species.

CŒLAMBUS.

C. acaroides *Lec.*
C. turbidus *Lec.*
C. nubilus *Lec.*

HYDROPORUS.

H. concinnus *Lec.*
H. pulcher *Lec.*
H. undulatus *Say.*
H. consimilis *Lec.*
H. modestus *Aube.*

ILYBIUS.

I. biguttatus *Germ.*

COPTOTOMUS.

C. interrogatus *Fab.*

COPELATUS.

C. glyphicus *Say.*

MATUS.

M. bicarinatus *Say.*

AGABUS.

A. stagninus *Say.*
A. tæniolatus *Harr.*
A. semivittatus *Lec.*

I have found this last species feeding on a bit of earth worm, floating in water. Placing my net under the worm, and raising it up, I counted 43 of the beetles.

DYTISCUS.

D. fasciventris *Say.*
D. harrisii *Kby.*
D. hybridus *Aube.*

ACILIUS.

A. semisulcatus *Aube.*
A. fraternus *Harr.*

THERMONECTES.

T. basilaris *Harr.*
T. fasciaticollis *Harr.*

CYBISTER.

C. fimbriolatus *Say.*

GYRINIDÆ.

"Surface Whirligigs."

GYRINUS.

G. confinis *Lec.*
G. lugens *Lec.*
G. analis *Say.*

DINEUTUS.

D. discolor *Aube.*
D. assimilis *Aube.*

HYDROPHILIDÆ.

HELOPHORUS.

H. lineatus *Say.*

HYDROPHILUS.

H. ovatus *H. & G.*
H. glaber *Hbst.*
H. triangularis *Say.*
H. striolatus *Lec.*
H. nimbatus *Say.*

Excepting *Dytiscus harrisii,* the first two are the largest water beetles found here. *H. ovatus* is shorter and broader and has the triangular piece, into which the anterior end of the sternal spine rests, open. *H. triangularis* is very common, and has the triangle mentioned above closed and complete.

HYDROCHARIS.

H. obtusatus *Say.*

BEROSUS.

B. peregrinus *Hbst.* B. striatus *Say.*

LACCOBIUS.

L. agilis *Rand.*

PHILHYDRUS.

P. nebulosus *Say.* P. cinctus *Say.*
P. ochraceus *Mels.*

HYDROCOMBUS.

H. maculicollis *Muls.* H. fimbriatus *Mels.*

HYDROBIUS.

H. globosus *Say.* H. subcupreus *Say.*

CERCYON.

C. pubescens *Lec.* C. hæmorhoidale *Fab.*
C. prætextatum *Say.*

PHÆNONOTUM.

P. extricatum *Say.*

MEGASTERNUM.

M. costatum *Lec.*

CRYPTOPLEURUM.

C. vagans *Lec.*

LEPTINIDÆ.

"Mammal Nest Dwellers."

LEPTINUS.

L. testaceus *Muell.*

This curious little flat, pale, eyeless beetle, I have found only in the nests of small mammals, such as field mice, etc. From one nest I took 90 specimens, and many escaped by running away so rapidly I was unable to gather them all. I think they are only guests of the animals, as I have found them in nests that have been long since deserted by the animals. See note, "What I found in nest of field mouse." This Journal, 1892.

SILPHIDÆ.

"Carrion Beetles."

NECROPHORUS.

N. americanus *Oliv.* N. marginatus *Fab.*

N. sayi *Lap.*
N. orbicollis *Say.*
N. tomentosus *Web.*

These large showy beetles are ill-smelling things, and when pinned, turn dark in drying and lose the bright yellow colors. Their appearance and smell can be much improved in preparing them for the cabinet, by making an opening between the segments and scraping out the soft parts. Then soak them for several days in ether or gasoline, after which fill up with cotton that has been dampened in carbolic acid, alcohol and corrosive sublimate. To secure specimens, place a dead mole, rat or bird in a suitable place, cover up lightly with bark or grass, and visit it daily during June, July, August and September.

SILPHA.

S. surinamensis *Fab.*
S. inæqualis *Fab.*
S. noveboracensis *Forst.*
S. americana *Linn.*

These frequent the same "banquet hall" as the above and require the same treatment. I have observed *S. surinamensis* feeding on the plump maggots of the "Blue fly." They were chewing them up at a lively rate.

NECROPHILUS.

N. pettitii *Horn.*

A rare species I have only found on fungus growing in thick woods.

CHOLEVA.

C. simplex *Say.*
C. basillaris *Say.*
C. clavicornis *Lec.*
C. terminans *Lec.*

These and the next occur on decaying vegetable and animal matter. I have also taken five specimens in nest of a mouse, June 12.

PRIONOCHÆTA.

P. opaca *Say.*

PTOMAPHAGUS.

P. consobrinus *Lec.*
P. pusio *Lec.*
P. parasitus *Lec.*

P. parasitus I find abundantly in the subterranean nests of a large black ant (Camponotus pennsylvanicus). July 21, 1891, I took 35 from a nest in an orchard. This ant makes nests in honeycombed trees and logs, and also in the ground.

COLON.

C. hubbardi *Horn.*
C. undescribed species.

COLENIS.

C. impunctata *Lec.*

LIODES.

L. polita *Lec.*
L. obsoleta *Horn.*
L. discolor *Melch.*
L. basilis *Lec.*
L. blanchardi *Horn.*
L. dichroa *Lec.*

Liodes are abundant in patches of powdery fungus that grows on logs and dead trees.

AGATHIDIUM.

A. oniscoides *Beauv.*
A. pulchrum *Lec.*
A. exiguum *Melsh.*

SCYDMÆNIDÆ.

Minute hairy brown beetles in which the elytra cover the dorsal segments of abdomen.

CHEVROLATIA.

C. amœna *Lec.*

More than twenty years ago, I took one specimen of this exceedingly rare species, and have never ceased hunting for others, whenever an opportunity offered, but without success.

SCYDMÆNUS.

S. cribrarius *Lec.*
S. clavipes *Say.*
S. flavitarsus *Lec.*
S. salinator *Lec.*
S. capillosulus *Lec.*
S. bicolor *Schauff.*
S. analis *Lec.*
S. brevicornis *Say.*

EUMICRUS.

E. motschulskii *Lec.*
E. floridanus *Casey.*
E. grossus *Lec.*

CHOLERUS.

C. zimmermani *Schaum.*

CEPHENNIUM.

C. corporosum *Lec.*

See Le Conte in Proc. Acad., 1852; also, "Coleopterological Notices: VII.", Annals N. Y. Acad. Sciences vol. IX, p. 351, by Maj. Casey.

PSELAPHIDÆ.

Minute brown beetles with the elytra not covering the dorsal abdominal segments. Segments not freely moveable.

ADRANES.

A. lecontei *Brend.*

ATINUS.

A. monilicornis *Brend.*

CEOPHYLLUS.

C. monilis *Lec.*

CEDIUS.

C. zeigleri *Lec.*
C. spinosus *Lec.*

TMESIPHORUS.

T. costalis *Lec.*
T. carinatus *Lec.*

CTENISTES.

C. piceus *Lec.*
C. zimmermani *Lec.*
C. consobrinus *Lec.*

TYRUS.

T. humeralis *Aube.*

TYCHUS.

T. minor *Lec.*

MACHÆRODES.

M. tychoides *Brend.*

VERTICINOTUS.

V. cornutus *Brend.*

BATRISUS.

B. confinis *Lec.*
B. monstrosus *Lec.*
B. ferox *Lec.*
B. frontalis *Lec.*
B. riparius *Say.*
B. globosus *Lec.*
B. nigricans *Lec.*
B. spretus *Lec.*

FARONUS.

F. tolulæ *Lec.*

See note on this species in this Journal, vol. XIX (1898), p. 139.

BRYAXIS.

B. illinoiensis *Brend.*
B. abdominalis *Aube.*
B. gracilis *Casey.*
B. rubicunda *Aube.*
B. congener *Brend.*

RHEXIUS.

R. insculptus *Lec.*

TRIMIUM.

T. parvulum *Lec.*

EUPLECTUS.

E. linearis *Lec.*
E. confluens *Lec.*
E. interruptus *Lec.*

Unless the PSELAPHIDÆ are collected clean and mounted with great care they are not worth much for study. Collect them

dry, draw out the antennæ, then mount on the extreme tip of the finest paper point, with only a speck of good glue. Brendel and Wickham have published a monograph of the family in the natural history bulletin of the Iowa Acad. Sciences: Vol. 1, p. 216. But the beginner who attempts to name his collection, without named types for comparison, from this or any other available literature, will have "rough sledding."

STAPHYLINIDÆ.

"Rove Beetles."

An immense family with diversified forms and colors, that have the elytra short, abdominal segments in most of the species fi eely moveable.

FALAGRIA.

F. cingulata *Lec.*
F. bilobata *Say.*

HOMALOTA.

H. trimaculata *Er.*
H. lividipennis *Mann.*

ALEOCHARA.

A. lata *Grav.*
A. brachypterus *Fourc.*

PHILOTERMES.

P. pilosus *Kr.*

DINOPSIS.

P. americanus *Kr.*

ACYLOPHORUS.

A. flavicollis *Sack.*
A. pronus *Erx.*

SOMATIUM.

S. claviger *Casey.*

QUEDIUS.

Q. fulgidus *Fab.*
Q. sublimbatus *Makl.*
Q. peregrinus *Grav.*
Q. capucinus *Grav.*
Q. lævigatus *Gyll.*
Q. molochinus *Grav.*

LISTOTROPHUS.

S. cingulatus *Grav.*

CREOPHILUS.

C. villosus *Grav.*

STAPHYLINUS.

S. vulpinus *Nordm.*
S. maculosus *Grav.*
S. mysticus *Er.*
S. femoratus *Fab.*
S. comes *Lec.*
S. cinnamopterus *Grav.*
S. violaceus *Grav.*
S. viridans *Horn.*

OCYPUS.

O. ater *Grav.*

BELONUCHUS.

B. formosus *Grav.*

PHILONTHUS.

P. aeneus *Rossi.*
P. lucidus *Say.*
P. palliatus *Grav.*
P. debilis *Grav.*
P. fusiformis *Melsh.*
P. fulvipes *Fab.*
P. lomatus *Er.*
P. æqualis *Horn.*
P. brunneus *Grav.*
P. cyanipennis *Fab.*
P. blandis *Grav.*
P. baltimorensis *Grav.*
P. apicalis *Say.*
P. confertus *Lec.*

ACTOBIUS.

A. sobrinus *Er.*
A. pæderoides *Lec.*
A. terminalis *Lec.*

XANTHOLINUS.

X. cephalus *Say.*
X. emmesus *Grav.*
X. obscurus *Er.*

LEPTACINUS.

L. longicollis *Lec.*
L. ruficollis *Lec.*
L. dimidiatus *Say.*
L. umbripennis *Fauv.*

DIOCHUS.

D. schaumii *Kr.*

STENUS.

S. bipunctatus *Er.*
S. egenus *Er.*
S. flavicornis *Er.*
S. annularis *Er.*
S. humilis *Er.*
S. artus *Csy.*
S. argus *Grav.*

EUÆSTHETUS.

E. floridæ *Casey.*

CRYPTOBIUM.

C. badium *Grav.*
C. bicolor *Grav.*
C. texanum *Lec.*
C. pallipes *Grav.*
C. latebricola *Nordm.*

LATHROBIUM.

L. punctulatum *Lec.*
L. armatum *Say.*
L. longiusculum *Grav.*
C. collare *Er.*
C. dimidiatum *Say.*

STILICUS.

S. tristis *Melch.*
S. angularis *Lec.*
S. dentatus *Say.*
S. biarmatus *Lec.*

17

LITHOCHARIS.

L. corticina *Grav.*
L. confluens *Say.*

PÆDERUS.

P. littorarius *Grav.*

SUNIUS.

S. binotatus *Say.*
S. longiusculus *Mann.*

STILICOPSIS.

S. monstrosa *Lec.*

PINOPHILUS.

P. latipes *Grav.*

PALAMINUS.

P. testaceus *Er.*

MICROCYPTUS.

M. testaceus *Lec.*

Taken in numbers from nest of small black ant, August, 1888.

TACHINUS.

T. memnonius *Grav.*
T. flavipennis *Dej.*
T. luridus *Er.*
T. schwarzi *Horn.*
T. limbatus *Melsh.*
T. pallipes *Grav.*

TACHYPORUS.

T. maculipennis *Lec.*
T. jocosus *Say.*
T. chrysomelinus *Linn.*
T. scitulus *Er.*
T. brunneus *Fab.*

ERCHOMUS.

T. lævis *Lec.*

CONOSOMA.

C. littoreum *Linn.*
C. crassum *Grav.*
C. basale *Er.*
C. opicum *Say.*
C. scriptum *Horn.*

BOLETOBIUS.

B. niger *Grav.*
B. dimidiatus *Er.*
B. intrusus *Horn.*
B. cincticollis *Say.*
B. trinotatus *Er.*
B. cinctus *Grav.*

BRYOPORUS.

B. flavipes *Lec.*

MYCETOPORUS.

M. americanus *Er.*

MEGALOPS.

M. cælatus *Grav.*

OXYPORUS.

O. femoralis *Grav.*
O. major *Grav.*
O. stygicus *Say.*
O. vittatus *Grav.*
O. lateralis *Grav.*

Megalops I always find on the under side of small fungus grown beech logs, May to October. *Oxyporus* feed on the tender parts of fungus belonging to the *Agaricinae* from May to September. *O. stygicus* is our most abundant species and quite variable in size.

OSORIUS.

O. latipes *Grav.*

BLEDIUS.

B. semiferrugineus *Lec.*
B. ruficornis *Lec.*
B. analis *Lec.*
B. emarginatus *Say.*

I find *Osorius* and *Bledius* abundant along rivers on the low damp ground.

PLATYSTETHUS.

P. americanus *Er.*

OXYTELUS.

O. sculptus *Grav.*
O. insignitus *Grav.*
O. nitidulus *Grav.*
O. placusinus *Lec.*

TROGOPHLŒUS.

T. memnonius *Er.*

APOCELLUS.

A. sphæricollis *Say.*

GEODROMICUS.

G. brunneus *Say.*
G. cæsus *Er.*

LESTEVA.

L. pallipes *Lec.*
L. subcarinata *Er.*

TRIGONODEMUS.

T. striatus *Lec.*

LATHRIMÆUM.

L. sordidum *Er.*

ALOPHRUM.

A. obtectum *Er.*
A. rotundicolle *Salb.*

PYCNOGLYPTA.

P. lurida *Gyll.*

HOMALIUM.

H. humerosum *Fauv.*

PHOTINUS.

P. atomarius *Er.*

MEGARTHRUS.

M. excisus *Lec.*

GLYPTOMA.

G. costale *Er.*

ELEUSIS.

E. pallidus *Lec.*

SIAGONUM.

S. americanum *Melsh.*

MICROPEPLUS.

M. cribratus *Lec.*

In addition to those enumerated I have many species impossible to identify at this time, some of which are doubtless new.

TRICHOPTERYGIDÆ.

"Feather Wings."

Most of these beetles are exceedingly minute, being the smallest of beetles. It requires a powerful glass to study them. I find only two species, by sifting rubbish. They are:

NOSSIDIUM.

N. americanum *Mots.*

TRICHOPTERYX.

T. haldemanii *Lec.*

SCAPHIDIIDÆ.

Black shining beetles that live on fungus grown logs.

SCAPHIDIUM.

S. quadrimaculatum *Say.* S. quadripustulatum *Say.*
S. obliteratum *Lec.* S. piceum *Melsh.*

S. obliteratum is a form in which the dorsal punctures are nearly obliterated. Dr. Horn considered the last three varieties of the first. Maj. Casey has a synopsis in Journal, N. Y. Ent. Soc., vol. VIII, June, 1900.

CYPARIUM.

C. flavipes *Lec.*

BÆOCERA.

B. concolor *Fab.*

Sifted from field mouse's nest December, 1891.

SCAPHISOMA.

S. convexum *Say.*

TOXIDIUM.

T. compressum *Zimm.*

PHALACRIDÆ.

OLIBRUS.

O. striatulus *Lec.*
O. consimilis *Marsh.*
O. nitidus *Melsh.*

ANCYLOMUS.

A. ergoti *Csy.*

CORYLOPHIDÆ.

Many of this family of small beetles are to be found on the trunks of standing dead trees feeding on a powdery fungus.

SACIUM.

S. obscurum *Lec.*
S. amabile *Lec.*
S. fasciatum *Say.*
S. lunatum *Lec.*

SERICODERUS.

S. obscurus *Lec.*
S. subtilis *Lec.*

COCCINELLIDÆ.

"Lady Bugs" or "Lady Birds."

This is one of the most important families of beetles. Many of the species in the larval form feed on plant lice and scale insects. Their value in ridding vegetation of these pests can hardly be estimated.

Introduced pests can sometimes be controlled by introducing their "Lady bug" parasite. The family is large and all, with few exceptions, feed on other insects. The rapidity with which *Adalia* and *Brachyacantha* will destroy a colony of "plant lice" (*aphidae*) is surprising. Our species are:

MEGILLA.

M. maculata *D. G.*

HIPPODAMIA.

H. glacialis *Fab.*
H. convergens *Guer.*
H. tredecimpunctata *Linn.*
H. parenthesis *Say.*

COCCINELLA.

C. venusta *Melsh.*
C. sanguinea *Linn.*

C. notulata *Muls.*
C. noveninotata *Hbst.*
C. bipunctata *Linn.*
C. pullata *Say.*

I have never observed *C.* (*Neoharmonia*) *venusta* and *C. notulata* here until 1898, in which year I saw one specimen. Since then they are becoming more abundant. I have specimens that seem to prove *notulata* a dimorphic form of *venusta.*

ANATIS.

A. quindecimpunctata *Oliv.*

PSYLLOBORA.

P. vigintimaculata *Say.*

CHILOCORUS.

C. bivulneratus *Muls.*
C. abdominalis *Say.*

CRYPTOGNATHA.

C. pusilla *Lec.*

PENTILIA.

P. misella *Lec.*

BRACHYACANTHA.

B. ursina *Fab.*
B. decempustulata *Melsh.*
B. quadripunctata *Melsh.*

HYPERASPIS.

H. fimbriolata *Melsh.*
H. undulata *Say.*
H. signata *Oliv.*
H. bigeminata *Rand.*

SCYMNUS.

S. bioculatus *Muls.*
S. americanus *Mulls.*
S. hæmorrhous *Lec.*
S. collaris *Melsh.*
S. caudalis *Lec.*
S. tenebrosus *Muls.*
S. punctatus *Melsh.*

CEPHALOSCYMNUS.

C. zimmermani *Cr.*

EPILACHNA.

E. borealis *Fab.*

I have found this last species in clusters under leaves during the winter. With very few exceptions our COCCINELLIDÆ are abundant if searched for at the proper time and place. Crotch published a revision of the family, Trans., vol. IV, 1873, p. 363.

Maj. Thos. L. Casey has published a revision and synopsis in Journal, New York Ent. Soc., vol. VII, No. 2, June, 1899.

ENDOMYCHIDÆ.

SYMBIOTES.

S. ulkei *Cr.*
S. minor *Cr.*

RHANIS.

R. unicolor *Zieg.*

PHYMAPHORA.

P. pulchella *Newm.*

LYCOPERDINA.

L. ferruginea *Lec.*

This last species is common if searched for at the proper place, which is inside the little round fungus *Lycoperdon piriforme,* where it may be found covered with the spores of the fungus. By squeezing the ball the beetle can be felt, if within.

APHORISTA.

A. vittata *Fab.*

MYCETINA.

M. perpulchra *Newm.*

STENOTARSUS.

S. hispidus *Hbst.*

ENDOMYCHUS.

E. bivittatus *Gerst.*

Mycetina and *Aphorista* I have found very early in Spring clinging to the under side of oak rails that were lying along the edge of a woods. The curious and pretty little *Phymaphora* is found on old beech logs. *Symbiotes* occurs on logs where it feeds on the fungus growing there.

For synopsis, see Crotch Trans. vol. IV, 1873, p. 349.

EROTYLIDÆ.

LANGURIA.

L. bicolor *Fab.*
L. mozardi *Lat.*
L. angustata *Bean.*
L. trifasciata *Say.*
L. gracilis *Newm.*

L. trifasciata is considered a variety of *L. angustata,* but I strongly doubt it.

PLŒOSOMA.

P. punctata *Lec.*

DACNE.

D. quadrimaculata *Say.*

MEGALODACNE.

M. fasciata *Fab.*
M. heros *Say.*
M. ulkei *Crotch.*

I have found *ulkei* only on a fungus (*Polyporus cuticularis*), growing on beech logs together with its larvæ. Under favorable conditions they were common during May and June. Thick woods.

ISCHYRUS.

I. quadripunctatus *Oliv.*

MYCOTRETUS.

M. sanguinipennis *Say.*
M. pulchra *Say.*

TRITOMA.

T. humeralis *Fab.*
T. biguttatus *Say.*
T. unicolor *Say.*
T. festiva *Lec.*
T. macra *Lec.*
T. thoracica *Say.*
T. flavicollis *Lec.*

Have bred *T. festiva* from fungus found growing on beech stump. The larvæ were voracious feeders, and consumed the entire inner part, leaving a thin shell, which held the piece together. Crotch has a revision. Trans. 1873, vol. IV, p. 349.

COLYDIIDÆ.

SYNCHITA.

L. parvula *Guer.*
L. fuliginosa *Melsh.*
L. granulata *Say.*

CICONES.

C. marginalis *Melsh.*

BITOMA.

B. quadrigutta *Say.*
B. quadricollis *Horn.*

EUDESMA.

E. undulata *Melsh.*

This species is rare. It was described by Melsheimer from Penn. For years it remained unique, until one day, while taking refuge under a buckeye log that spanned a ravine, to escape a shower, I looked up and saw some curious little elongated beetles running rapidly up and down the log, and running into round holes in a very colydiid fashion. I gathered six specimens, and when I studied them, found I had this rare insect. Mr. Siewers had taken one specimen under bark of sycamore the year before (1879) in same woods. This beautiful woods is now gone. I have not seen the species since.

COXELUS.

C. guttulatus *Lec.*

LASCONOTUS.

L. pusillus *Lec.*

AULONIUM.

A. parallelopipedum *Say.* A. tuberculatum *Lec.*

COLYDIUM.

C. lineola *Say.*

PENTHELISPA.

P. reflexa *Say.*

PYCNOMERUS.

P. sulcicollis *Lec.*

BOTHRIDERES.

B. geminatus *Say.*

EROTYLATHRIS.

E. exaratus *Melsh.*

I found this nicely sculptured species but once abundantly. It was hatching from cocoons, that its larvæ had constructed under the bark of a dead Elm tree. Many pupa had died in the cocoons evidently from the heat of the sun shinning on the bark.

CERYLON.

C. castaneum *Say.*

PHILOTHERMUS.

P. glabriculus *Lec.*

MYCHOCERUS.

M. depressus *Lec.*

See Dr. Horn's paper on *Colydiidae,* Proc. Amer. Phil. Soc. 1878, Vol. XVII, p. 555.

RHYSSODIDÆ.

RHYSSODES.

R. exarata *Ill.*

CLINIDIUM.

C. sculptile *Newm.*

See synopsis by LeConte Trans., V. 5, 1875, p. 162. There are only four N. A. species in the family. The other two being found in Cal. Ours live under bark of decaying logs, and are abundant.

CUCUJIDÆ.

SYLVANUS.

S. surinamensis *Linn.*
S. bidentatus *Fab.*
S. planatus *Germ.*
S. advena *Waltl.*

NAUSIBIUS.

N. dentatus *Marsh.*

CATOGENUS.

C. rufus *Fab.*

PEDIACUS.

P. depressus *Hbst.*

CUCUJUS.

C. clavipes *Fab.*

INO.

Undescribed species.

I found one specimen of this last genus by beating the dead limbs of honey locust. Mr. Ulke to whom I gave it, said it was new. I never saw another.

LÆMOPHLŒUS.

L. biguttatus *Say.*
L. fasciatus *Melsh.*
L. adustus *Lec.*
L. testaceus *Fab.*
L. convexulus *Lec.*

LATHROPUS.

L. vernalis *Lec.*

BRONTES.

B. dubius*Fab.*
B. debilis *Lec.*

TELEPHANUS.

T. velox *Hald.*

Synopsis by LeConte Proc. Acad. 1854, V. 7, p. 73. The species of this family are very striking examples of forms modified for an existence under the loose close laying bark of trees, enabling them to squeeze into crevices where they find food for their larvæ, and the eternally vigilant ant can not penetrate.

CRYPTOPHAGIDÆ.

LOBERUS.

L. impressus *Lec.*

ANTHEROPHAGUS.

A. ochraceus *Mels.*

CROSIMUS.

C. hirtus *Casey*.

CRYPTOPHAGUS.

C. croceus *Zimm*.

C. nodangulus *Zimm*.

CÆNOSCELIS.

C. subfuscata *Casey*.

C. ferruginea *Sahlb*.

C. elongata *Csy*.

C. obscura *Csy*.

ATOMARIA.

A. crypta *Casey*.

A. ephippiata *Zimm*.

A number of unnamed CRYPTOPHAGIDÆ.

MYCETOPHAGIDÆ.

"Fungus eaters."

MYCETOPHAGUS.

M. punctatus *Say*.

M. flexuosus *Say*.

M. melsheimerii *Lec*.

M. pluripunctatus *Lec*.

M. obsoletus *Melsh*.

PISENUS.

P. humeralis *Kby*.

LITARGUS.

L. 6-punctatus *Say*.

L. balteatus *Lec*.

L. tetraspilotus *Lec*.

L. didesmus *Say*.

L. nebulosus *Lec*.

TYPHÆA.

T. fumata *Linn*.

DIPLOCŒLUS.

D. brunneus *Lec*.

Synopsis by Casey in Journal N. Y. Ent. Soc., June, 1900.

DERMESTIDÆ.

"Museum and household pests."

DERMESTES.

D. lardarius *Linn*.

D. pulcher *Lec*.

D. vulpinus *Fabr*.

D. maculatus *Dej*.

ATTAGENUS.

A. piceus *Oliv*.

TROGODERMA.

T. ornatum *Say*.

T. tarsale *Melsh*.

ANTHRENUS.

A. scrophulariæ *Linn.*
A. musæorum *Linn.*
A. varius *Fab.*

CRYPTORHOPALUM.

C. balteatum *Lec.*

ORPHILUS.

O. glabratus *Fab.*

Anthrenus is a terrible pest, and unless the utmost vigilance is exercised they will get into and ruin an insect collection in a short time. The strong fumes of napthaline or crude carbolic acid will disguise the odor of dried insects and repell the pests from the boxes. Strong carbon bi-sulphide fumes will kill *Anthrenus* after they get in. Maj. Casey has a synopsis in Journal N. Y. Ent. Soc., June, 1900.

HISTERIDÆ.

Our species are nearly all black shining beetles that live in excrement and decaying material. Some few species live under bark and are modified for such an existence being flattened and with short legs.

HOLOLEPTA.

H. lucida *Lec.*
H. fossularis *Say.*

HISTER.

H. harrisii *Kby.*
H. immunis *Cr.*
H. marginicollis *Lec.*
H. fœdatus *Lec.*
H. abbreviatus *Fab.*
H. furtivus *Lec.*
H. incertus *Mars.*
H. servus *Er.*
H. sedecimstriatus *Say.*
H. americanus *Payk.*
H. subrotundus *Say.*
H. vernus *Say.*
H. carolinus *Payk.*
H. lecontei *Mars.*
H. aurelianus *Horn.*
H. coarctatus *Lec.*
H. basalis *Lec.*
H. gracilis *Lec.*

TRIBALUS.

T. americanus *Lec.*

EPIERUS.

E. regularis *Beauv.*
E. pulicarius *Er.*

HETÆRIUS.

H. brunneipennis *Rand.*

I have taken this species by digging into the nests of mound building ants (*Formica exsectoides*).

DENDROPHILUS.

D. punctulatus *Say.*

PAROMALUS.

P. æqualis *Say.*
P. estriatus *Lec.*
P. bistriatus *Er.*
P. seminulum *Er.*

SAPRINUS.

S. assimilis *Payk.*
S. fraternus *Say.*
S. fitchii *Mars.*
S. patruelis *Lec.*

TERETRIUS.

T. americanus *Lec.*

BACANIUS.

B. punctiformis *Lec.*

ACRITUS.

A. exiguus *Er.*

AULETES.

A. undescribed species.

NITIDULIDÆ.

"Sap feeders."

Members of this family can be found in quantities, whereever sap exudes from trees, early in the spring. This is particularly the case with maple trees. I have trapped hundreds by laying chips on top of a freshly cut maple stump, where the sap was exuding. Under these chips were congregated 20 species and hundreds of individuals. A mixture of vinegar or sour beer, and brown sugar or molasses, will also attract them, if spread on a log in the woods, and covered with chips.

CERCUS.

C. abdominalis *Er.*

CARPOPHILUS.

C. hemipterus *Linn.*
C. niger *Say.*
C. marginatus *Say.*
C. corticinus *Er.*
C. antiquus *Melsh.*

COLASTUS.

C. morio *Er.*
C. maculatus *Er.*
C. semitectus *Say.*
C. truncatus *Rand.*

CONOTELUS.

C. obscurus *Er.*

EPURÆA.

E. hornii *Cr.*
E. helvola *Er.*
E. rufa *Say.*
E. erichsonii *Reit.*
E. corticina *Er.*
E. rufida *Melsh.*
E. avara *Rand.*
E. fulvescens *Horn.*
E. planulata *Er.*
E. ovata *Horn.*
E. labilis *Er.*

and some unidentified species.

NITIDULA.

N. bipustulata *Linn.*
N. zic zac *Say.*

STELIDOTA.

S. geminata *Say.*
S. octomaculata *Say.*
S. strigosa *Gyll.*

PROMETOPIA.

P. sexmaculata *Say.*

PHENOLIA.

P. grossa *Fab.*

OMOSITA.

O. colon *Linn.*

SORONIA.

S. undulata *Say.*

POCADIUS.

P. helvolus *Er.*

MELIGETHES.

M. mutatus *Harr.*

OXYCNEMIS.

O. nigripennis *Lec.*
O. histrina *Lec.*

The last two species very much resemble *Histers* and are found in the curious fungus called the "stink horn."

AMPHICROSSUS.

A. ciliatus *Oliv.*

PALLODES.

P. silaceus *Er.*

CYBOCEPHALUS.

C. nigritulus *Lec.*

These minute little beetles are found on fungus grown logs They are sometimes in clusters composed of hundreds of individuals.

CRYPTARCHA.

C. ampla *Er.*
C. concinna *Melsh.*

IPS.

I. fasciatus *Oliv.*
I. confluentus *Say.*
I. sanguinolentus *Oliv.*

RHIZOPHAGUS.

R. bipunctatus *Say.*

Dr. Horn's paper on this family, Trans., 1879, V. 7, p. 257, is the best synopsis of the North American *Nitidulidae.*

LATHRIDIIDÆ.

A family of minute beetles that live under the bark of trees, in decaying leaves, etc. I collect them by sifting such debris.

LATHRIDIUS.

L. liratus *Lec.*

ENICMUS.

E. maculatus *Lec.*
E. aterrimus *Mots.*

CARTODERE.

C. filiformis *Lec.*

CORTICARIA.

C. serrata *Payk.*
C. brevicornis *Fall.*

MELANOPHTHALMA.

M. picta *Lec.*
M. distinguenda *Com.*
M. cavicollis *Mann.*
M. americana *Mann.*

When more careful search for them is made, other species will doubtless be found here. In a deserted nest of our common "wild rabbit" (*Lepus sylvaticus*), I found 31 *Corticaria serrata,* together with what I suppose was their larvæ. They were feeding on the epithelial scales and other debris of the rabbit. With them were two other species. See Revision of Family, by H. C. Fall, "Trans," XXVI, 1899, pp. 101-190.

TROGOSITIDÆ.

Mostly elongate cylindrical or elongate flat species that live under the bark of dead trees.

NEMOSOMA.

N. cylindricum *Lec.*

ALINDRIA.

A. cylindrica *Serv.*

TROGOSITA.

T. virescens *Fab.*

This species has been introduced with logs brought to the saw mills I think.

TENEBRIOIDES.

T. mauritanica *Linn.*
T. castanea *Melsh.*
T. dubia *Melsh.*
T. bimaculata *Melsh.*
T. marginata *Beauv.*

GRYNOCHARIS.

G. 4-lineata *Mels.*

This is a very rare species. I have only taken three.

MONOTOMA.

M. producta *Lec.*
M. fulvipes *Mels.*
M. picipes *Hbst.*

HESPEROBÆNUS.

H. rufipes *Lec.*

EUROPS.

E. pallipennis *Lec.*

BACTRIDIUM.

B. ephippigerum *Guer.*
B. striolatum *Reit.*

DERODONTIDÆ.

Our only species of the family is very abundant in fungi.

DERODONTUS.

D. maculatus *Mels.*

BYRRHIDÆ.

"Pill Beetles."

Some of the genus *Byrrhus*, when they have their pubescence perfect, are a pill the Coleopterist likes to take—— into his bottle. Only two species occur here, they are

NOSODENDRON.

N. unicolor *Say.*

LIMNICHUS.

L. sp.

GEORYSSIDÆ.

Small round coarsely punctured black beetles that live on the

muddy shores of streams. They cover themselves with mud, so they are very difficult to see, consequently but few of our collectors get them. Our only species is

GEORYSSUS.

G. pusillus *Lec.*

PARNIDÆ.

This is an aquatic family, that live submerged in running water, clinging to flat stones or logs. Their larvæ are flat, thin creatures that do not look like the larvæ of an insect. I have found the seven species that we take here, together with the larvæ of some of them, adhering to submerged logs and stones in the swift running water of Mill Creek and the Little Miami river. By taking an old limb or rough stone from the water at a suitable locality and placing it in the sun, the insects will move as the water dries off, although at first nothing can be seen of them, so perfectly do they resemble the surface on which they rest. In Trans., V. 3, 1870, p. 29. Dr. Horn has a synoptic paper on them.

HETEROCERIDÆ.

A family of rather elongate, convex, pubescent, mud colored beetles, that burrow in the mud. The foretibiæ are broad and flattened, enabling the insect to dig out of sight with great celerity. When the mud flat in which they are concealed is shaken or water poured over it, they rush out of their burrows and take flight. Dr. Horn has an admirable paper on the N. A. species in Trans., Vol. XVII, p. 1.

HETEROCERUS.

H. ventralis *Mels.*
H. undatus *Mels.*
H. brunneus *Mels.*
H. collaris *Kies.*
H. pusillus *Say.*

DASCYLLIDÆ.

A family of rather soft texture and small size, variable in color. Some are found on dead timber. One species of *Ectopria,* I have found clinging to a stone submerged in a swift running creek, June 29.

PTILODACTYLA.

P. angustata *Horn.*

EUCINETUS.

E. oviformis *Lec.*
E. morio *Lec.*
E. terminalis *Lec.*

ECTOPRIA.

E. nervosa *Melsh.*

PRIONOCYPHON.

P. discoideus *Say.*

HELODES.

H. pulchella *Guer.*
H. thoracica *Guer.*
H. fuscipennis *Guer.*

SCIRTES.

S. tibialis *Guer.*
S. orbiculatus *Fab.*

CYPHON.

C. ruficollis *Say.*
C. variabilis *Thunb.*
C. obscurus *Guer.*

See Horn's paper, Trans., 1880, V. 8, p. 76.

RHIPICERIDÆ.

ZENOA.

Z. picea *Beauv.*

SANDALUS.

S. niger *Knoch.*
S. petrophya *Knoch.*

For note on life history of *Sandalus niger,* see paper I published in this journal, Vol. XIX, No. 5, p. 172. I do not know of any complete paper up to date, on the N. A. members of this family. Dr. Horn has a synopsis of *Sandalus,* Trans. 1881, Vol. 9, p. 86.

ELATERIDÆ.

This great family is richly represented here. The N. A. species are much in need of a revision to include the new species discovered since Le Conte's paper, Trans. Amer. Philosophical Soc., 1853. N. Series, vol. x, pp. 405-508. The *Eucneminae, Cerophytinae* and *Perothopinae* have been done in an admirable manner by Dr. Horn. Trans., January, 1886, pp. 5-58.

The Elaters are popularly known as "Spring beetles," "Click beetles" and "Snapping bugs." Their larvae live mostly in decaying wood and in the ground, on plant roots, and are called "wire worms." The adult beetles are found in a great variety of places, on the trunks and foliage of trees, under bark, and early in the Spring, under stones, on the ground, etc. Our species are:

MELASIS.

M. pectinicornis *Melsh.*

From a beech log about four feet long I took 50 specimens, that were emerging from round holes they had made. May 27, 1892.

THAROPS.

T. ruficornis *Say.*

STETHON.

S. pectorosus *Lec.*

A rare species I found here years ago, feeding on fungus that was growing on the underside of a poplar log. Miss Braun found it under bark, 1901.

EUCNEMIS.

E. americana *Horn.*

Have only seen three specimens; all taken on dead beech.

DELTOMETOPUS.

D. amœnicornis *Say.*
D. rufipes *Mels.*

DROMÆOLUS.

D. cylindricollis *Say.*
D. harringtoni *Horn.*

FORNAX.

F. badius *Melsh.*
F. calceatus *Say.*
F. hornii *Bonv.*
F. molestus *Bonv.*
F. orchesides *Newm.*

ENTOMOPHTHALMUS.

E. rufiolus *Lec.*

MICRORHAGUS.

M. pectinatus *Lec.*
M. audax *Horn.*
M. subsinuatus *Lec.*
M. impressicollis *Bonv.*
M. bonvouloiri *Horn.*
M. humeralis *Say.*
M. triangularis *Say.*

All found running about dead timber in the sunshine, or resting in the crevices later in the day.

HYPOCŒLUS.

H. frontosus *Say.*
H. terminalis *Lec.*

NEMATODES.

N. atropos *Say.*
N. penetrans *Lec.*

The members of the *Eucneminæ* above, have not the power so developed, as have the more typical Elaters, of "snapping," "clicking" or springing up in the air, when laid on their backs.

ADELOCERA.

A. impressicollis *Say.*
A. marmorata *Fab.*
A. discoidea *Web.*
A. aurorata *Lec.*
A. maculata *Lec.*
A. avita *Say.*

CHALCOLEPIDIUS.

C. viridipilis *Say.*

ALAUS.

A. oculatus *Linn.*

HEMIRHIPUS.

H. fascicularis *Fab.*

This large handsome species was taken July 14 at Redbank.

CARDIOPHORUS.

C. convexus *Say.*

See paper by F. Blanchard. Trans., January, 1889.

HORISTONOTUS.

H. curiatus *Say.*

CRYPTOHYPNUS.

C. pulchellus *Linn.*
C. pectoralis *Horn.*
C. obliquatulus *Mels.*
C. perplexus *Horn.*
C. æstivus *Horn.*
C., undescribed species, allied to *C. striatulus.*

ŒDOSTETHUS.

O. femoralis *Lec.*

ANCHASTUS.

A. binus *Say.*

MONOCREPIDIUS.

M. lividus *Dej.*
M. suturalis *Lec.*
M. vespertinus *Fab.*
M. auritus *Hbst.*
M. bellus *Say.*

ISCHIODONTUS.

I. soleatus *Say.*

ELATER.

E. hepaticus *Melsh.*
E. pedalis *Cand.*
E. nigricollis *Hbst.*
E. linteus *Say.*
E. discoideus *Fab.*
E. læsus *Lec.*
E. impolitus *Melsh.*
E. rubricollis *Hbst.*
E. obliquus *Say.*

DRASTERIUS.

D. elegans *Fab.*

MEGAPENTHES.

M. limbalis *Hbst.*

LUDIUS.

L. attenuatus *Say.*
L. abruptus *Say.*

ORTHOSTETHUS.

O. infuscatus *Germ.*

AGRIOTES.

A. mancus *Say.*
A. oblongicollis *Melsh.*
A. pubescens *Melsh.*

GLYPHONYX.

G. recticollis *Say.*
G. testaceus *Melsh.*

MELANOTUS.

M. corticinus *Say.*
M. macer *Lec.*
M. decumanus *Er.*
M. fissilis *Say.*
M. communis *Gyll.*
M. exuberans *Lec.*
M. parumpunctatus *Melsh.*
M. verberans *Lec.*
M. paganus *Chd.*
M. pertinax *Say.*
M. americanus *Hbst.*
M. insipiens *Say.*
M. gradatus *Lec.*
M. morosus *Cand.*
M. sagittarius *Lec.*

LIMONIUS.

L. auripilis *Say.*
L. aurifer *Lec.*
L. griseus *Beauv.*
L. interstitialis *Melsh.*
L. confusus *Lec.*
L. quercinus *Say.*
L. maculicollis *Mots.*
L. agonus *Say.*
L. ornatipennis *Lec.*

CAMPYLUS.

C. denticornis *Kby.*

ATHOUS.

A. brightwelli *Kby.*
A. acanthus *Say.*
A. scapularis *Say.*
A. posticus *Melsh.*
A. rufifrons *Rand.*

LEPTOSCHEMA.

L. bicolor *Lec.*

BLADUS.

B. quadricallis *Rand.*

NOTHODES.

N. dubitans *Lec.*

SERICOSOMUS.

S. silaceus *Say.*
S. flavipennis *Mots.*

CORYMBITES.

C. vernalis *Hentz.*
C. cylindriformis *Hbst.*
C. divaricatus *Lec.*
C. pyrrhos *Hbst.*
C. æthiops *Hbst.*
C. hamatus *Say.*
C. splendens *Ziegl.*
C. inflatus *Say.*

C. bivittatus *Melsh.*
C. tarsalis *Melsh.*
C. copei *Horn.*
C. sulcicollis *Say.*
C. planatus *Lec.*
C. crassus *Lec.*
C. rotundicollis *Say.*

Some of these are very rare, as *C. copei.* I have only seen two specimens. *C. vernalis* lives in the clay clinging to the roots of trees that have been uprooted by storms. It appears in March and April. March 23, 1902, I took what I think was its larvæ, by digging in the clay-covered roots of an upturned beech tree. Mrs. Braun found *C. hamatus* on the foliage of honey locust June 1, 1902.

ASAPHES.

A. indistinctus *Lec.*
A. decoloratus *Say.*
A. planatus *Lec.*
A. memnonius *Hbst.*
A. bilobatus *Say.*

MELANACTES.

M. piceus *De G.*
M. puncticollis *Lec.*

PEROTHOPS.

P. mucida *Gyll.*

CEROPHYTUM.

C. pulsator *Hald.*

This last is one of the rarest known Elaters, as well as the most abberrant. Its pectinate antennæ are very curious. But one specimen has been taken here, and that was beaten from foliage, into an umbrella. I have in addition to the above many Elaters without names, some of them very fine ones.

THROSCIDÆ.

DRAPETES.

D. geminatus *Say.*
D. quadripustulatus *Bonv.*

THROSCUS.

T. punctatus *Bonv.*
T. constrictor *Say.*
T. chevrolati *Bonv.*

The monograph of the THROSCIDÆ by Bonvouloir, 1859, is inaccessible to most students. See Horn's synopsis of N. A species. Trans. Am. Ent. Soc., 1885, vol. XII, pp. 198-208.

BUPRESTIDÆ.

"Metallic Shiners."

This family is not very abundant here. They are most beautiful metallic insects. Some of the tropical species are really magnifi-

cent. Many of the species are very destructive to trees, etc. *Chrysobothris* has killed some of our pine trees outright, and did considerable damage to fruit trees. I collect them on the trunks of dead trees and beat them from foliage into an umbrella. *Buprestis rufipes* is our most beautiful species, I have found its larvæ boring in beech and maple. During June specimens may be found sunning themselves on the trunks of dead beech and other trees. Approach them stealthily or they will drop into the weeds and be lost. From a single dead beech in Avondale over a hundred *rufipes* emerged or perished in the attempt. June to September.

CHALCOPHORA.

C. campestris *Say.*

Abundant; cuts its way out of beech and maple in April, May and June.

DICERCA.

D. divaricata *Say.*
D. obscura *Fab.*

PŒCILONOTA.

P. cyanipes *Say.*

BUPRESTIS.

B. rufipes *Oliv.*
B. fasciata *Fab.*
B. striata *Fab.*

The last two have been taken about lumber yards where pine timber was being sawed and were perhaps introduced into the locality.

CINYRA.

C. gracilipes *Melsh.*

MELANOPHILA.

M. longipes *Say.*

ANTHAXIA.

A. viridifrons *Say.*
A. viridicornis *Say.*
A. cyanella *Gory.*
A. quercata *Fab.*

CHRYSOBOTHRIS.

C. femorata *Oliv.*
C. floricola *Gory.*
C. pusilla *Lap.*
C. sexsignata *Say.*
C. azurea *Lec.*
C. scitula *Gory.*

ACTENODES.

A. acornis *Say.*

A large unidentified species, that is perhaps new.

ACMÆODERA.

A. ornata *Fab.*
A. pulchella *Hbst.*
A. culta *Web.*

PTOSIMA.

P. gibbicollis *Say.*

AGRILUS.

A. difficilis *Gory.*
A. ruficollis *Fab.*
A. otiosus *Say.*
A. crinicornis *Horn.*
A. arcuatus *Say.*
A. bilineatus *Web.*
A. granulatus *Say.*
A. acutipennis *Mann.*
A. politus *Say.*
A. fallax *Say.*
A. obsoletoguttatus *Gory.*
A. subcinctus *Gory.*
A. lecontei *Saund.*
A. addendus *Cr.*
A. egenus *Gory.*
A. pusillus *Say.*

TAPHROCERUS.

T. gracilis *Say.*

BRACHYS.

B. ovata *Web.*
B. ærosa *Melsh.*
B. æruginosa *Gory.*

PACHYSCELUS.

P. purpureus *Say.*
P. lævigatus *Say.*

I have taken *Agrilus bilineatus* boring out of a solid beech tree. *A. ruficollis* bores in the stems of blackberry and raspberry. *A. lecontei* I find abundantly on honey locust. The others can be beaten from foliage into an umbrella. *Pachyscelus purpureus* I have taken eating holes in the leaves of wild geranium (*Geranium maculatum.*)

LAMPYRIDÆ.

"Fire Flies."

Soft bodied insects, many of which do not resemble beetles very closely. They rest during the day, but in the evening become active and fly about. The luminous species giving off their brilliant light. The life history of even many of the common species is unknown. Dr. Le Conte published a synopsis of N. A. species in Trans., 1881, vol. IX, pp. 15-72. Since then, Dr. Horn has published a paper on *Zaripus*. Trans., 1885, vol. XII, p. 148. Our species are:

LYCOSTOMUS.

L. lateralis *Melsh.*

CALOPTERON.

C. terminale *Say.*
C. reticulatum *Fab.*

LOPHEROS.

L. fraternus *Rand.*

EROS.

E. thoracicus *Rand.*
E. mundus *Say.*
E. aurora *Hbst.*
E. sculptilis *Say.*
E. humeralis *Fab.*

E. aurora is a beautiful red species quite rare here.

PLATEROS.

P. modestus *Say.*
P. canaliculatus *Say.*
P. floralis *Melsh.*

CALOCHROMUS.

C. perfacetus *Say.*

POLYCLASIS.

P. bifaria *Say.*

Superficially this species resembles the next, but it is quite different. I find them resting on trunks of trees in shady woods.

LUCIDOTA.

L. atra *Fab.*

ELLYCHNIA.

E. corrusca *Linn.*

PYROPYGA.

P. nigricans *Say.*
P. decipiens *Harr.*

PYRACTOMENA.

P. angulata *Say.*
P. lucifera *Melsh.*
P. pyralis *Linn.*
P. marginellus *Lec.*
P. scintillans *Say.*

PHOTURIS.

P. pennsylvanica *De G.*
P. frontalis *Lec.*

PHENGODES.

P. plumosa *Oliv.*

Very rare, only one male taken.

OMETHES.

O. marginatus *Lec.*

CHAULIOGNATHUS.

C. pennsylvanica *De G.*
C. marginata *Fab.*

PODABRUS.

P. tricostatus *Say.*
P. rugosulus *Lec.*
P. basilaris *Say.*
P. tomentosus *Say.*
P. protensus *Lec.*

SILIS.

S. percomis *Say.*

TELEPHORUS.

T. dentiger *Lec.*
T. excavatus *Lec.*
T. fraxini *Say.*
T. carolinus *Fab.*
T. lineola *Fab.*
T. rectus *Melsh.*
T. flavipes *Lec.*
T. scitulus *Say.*
T. pusillus *Lec.*
T. bilineatus *Say.*

DITEMNUS.

D. bidentatus *Say.*

TRYPHERUS.

T. latipennis *Germ.*

MALTHINUS.

M. flavicollis *Lec.*

MALTHODES.

M. exilis *Mels.*

These insects make very unsatisfactory looking specimens at best. Some methods of preparation are much better than others. Collect them dry, pin with good black pins, hold the head thorax and elytra in position until dry, and dry quickly. All of the smaller species should be mounted on paper triangles. A little alcoholic sol. of carbolic acid or corrosive sublimate injected into the soft abdominal parts is good.

MALACHIIDÆ.

Small, rather soft bodied beetles that occur on vegetation. But little is known of their life history. Synopsis by Horn. Trans., 1872, vol. III, p. 79.

COLLOPS.

C. quadrimaculatus *Fab.*

ANTHOCOMUS.

A. erichsoni *Lec.*

PSEUDEBÆUS.

P. bicolor *Lec.*

ATTALUS.

A. morulus *Lec.*
A. humeralis *Lec.*
A. scincetus *Say.*

MELYRIS.

M. cribratus *Lec.*

CLERIDÆ.

The clerids are an enterprising and interesting family. I find most of the species about dead timber. A few occur on foliage. Synopsis by Le Conte. Ann. Lyc., 1849, vol. v, p. 9.

ELASMOCERUS.

E. terminatus *Say.*

TILLUS.

T. collaris *Spin.*

Only one of this species has been taken here.

CYMATODERA.

C. brunnea *Melsh.*
C. bicolor *Say.*
C. undulata *Say.*

PRIOCERA.

P. castanea *Newm.*

A rare species, taken under bark.

TRICHODES.

T. quadrimaculatus *Say.*
T. analis *Lec.*
T. rosmarus *Say.*
T. ichneumoneus *Fab.*
T. thoracicus *Oliv.*

THANEROCLERUS.

T. sanguineus *Say.*

HYDNOCERA.

H. unifasciata *Say.*
H. subænea *Spin.*
H. humeralis *Say.*
H. pallipennis *Say.*
H. pedalis *Lec.*
H. verticalis *Say.*
H. tabida *Lec.*
H. longicollis *Ziegl.*

PHYLLOBÆNUS.

P. dislocatus *Say.*

ICHNEA.

I. laticornis *Say.*

CHARIESSA.

C. pilosa *Forst.*

CREGYA.

C. oculata *Say.*
C. mixta *Lec.*

I have beaten a number of *Cregya* from osage orange hedges.

ORTHOPLEURA.

O. damicornis *Fab.*

NECROBIA.

N. rufipes *Fab.*
N. ruficollis *Fab.*
N. violaceus *Linn.*

I have taken *Necrobia* on an old decaying animal skin.

PTINIDÆ.

PTINUS.

P. fur *Linn.*
P. brunneus *Duft.*
P. quadrimaculatus *Melsh.*

EUCRADA.

E. humeralis *Melsh.*

Abundant on trunks of dead beech.

ERNOBIUS.

E. mollis *Linn.*

OLIGOMERUS.

O. sericans *Melsh.*
O. alternans *Lec.*

SITODREPA.

S. panicea *Linn.*

Found abundantly in drugs, etc.

HADROBREGMUS.

H. carinatus *Say.*
H. linearis *Lec.*

TRICHODESMA.

T. gibbosum *Say.*

ANOBIUM.

A. notatum *Say.*

TRYPOPITYS.

T. sericeus. *Say.*

PETALIUM.

P. bistriatum *Say.*

EUPACTUS.

E. nitidus *Lec.*

XYLETINUS.

X. peltatus *Harr.*
X. fucatus *Lec.*

HEMIPTYCHUS.

H. punctatus *Lec.*
H. gravis *Lec.*
H. borealis *Lec.*
H. ventralis *Lec.*
H. castaneus *Ham.*

DORCATOMA.

D. setulosum *Lec.*

CÆNOCARA.

C. oculata *Say.*

PTILINUS.

P. ruficornis *Say.* P. thoracicus *Rand.*

EUCERATOCERUS.

E. hornii *Lec.*

ENDECATOMUS.

E. reticulatus *Hbst.* E. rugosus *Rand.*

SINOXYLON.

S. basilare *Say.* S. bidentatum *Horn.*
S. sextuberculatum *Lec.*

BOSTRYCHUS.

B. bicornis *Web.* B. truncaticollis *Lec.*

DINODERUS.

D. punctatus *Say.*

LYCTUS.

L. striatus *Melsh.* L. opaculus *Lec.*

TROGOXYLON.

T. parallelopipedum *Walsh.*

I do not know of any complete paper on the PTINIDÆ. Le Conte and Horn have papers on several sub-families and genera in Proc. Acad., 1865, and Proc. Amer. Philos. Soc., 1878.

CUPESIDÆ.

CUPES.

C. concolor *West.*

LYMEXYLIDÆ.

HYLECŒTUS.

H. lugubris *Say.*

Very rare here, one only.

CIOIDÆ.

CIS.

C. creberrimus *Mellie.* C. fuscipes *Mellie.*
Many unnamed species.

ENNEARTHRON.

E. thoracicornis *Zieg.* E. vitulus *Mann.*

CERACIS.

C. sallei *Mellie.*

RHIPIDANDRUS.

R. paradoxus *Beauv.*

The minute cioids I have found abundantly on fungus.

SPHINDIDÆ.

SPHINDUS.

S. denticollis *Lec.*

This species occurs on fungus.

LUCANIDÆ.

"The Stag Beetles."

The larvæ of our species live in decaying wood. Chas. Fuchs in Bull. Brooklyn Ent. Soc., 1882, vol. v, p. 49, has a good synopsis of the family.

LUCANUS.

L. elaphus *Fab.* L. placidus *Say.*
L. dama *Fab.*

DORCUS.

D. parallelus *Say.*

PLATYCERUS.

P. quercus *Webr.*

PASSALUS.

P. cornutus *Fab.*

L. elaphus is rare here, the others common. While in the British Museum some years ago, a specialist, who was working on the LUCANIDÆ, expressed a wish for some fresh *Passalus,* for dissection. On my return to Ohio, I sent some in a small box by mail. About a month after my box, like the proverbial cat in the song, "came back," and stamped on it in red letters, were these words: "Suspected to be potato beetles, not allowed entry." The specimens had been examined very carefully, and after due deliberation, they decided that a dead *Passalus cornutus* was a living "potato beetle"!

SCARABÆIDÆ.

An extensive family of large insects. Some of the tropical forms are giants of the beetle tribe. *Dynastes*, sometimes called the "Rhinoceros beetle," is our largest coleopteron. Its larva is a huge grub of a dirty yellowish color, and feeds on decaying wood. One of the peculiarities of this species is the very powerful and strange odor given off by the adult beetle. In a Bulletin of U. S. Dept. of Agriculture, New Series No. 36, page 28, is a paper on the species, with most superb figures of the larva and pupa, natural size. In collecting the coprophagous *Scarabæidæ* by throwing the dung, in which many species live, into a bucket of water they will come out and can thus be cleaned, before being put into the bottle.

CANTHON.

C. depressipennis *Lec.*
C. vigilans *Lec.*
C. lævis *Drury.*
C. chalcites *Hald.*
C. viridis *Beauv.*

Some of these are skillful ball rollers. Specimens of *C. viridis* from Texas are bright green, ours are always rich bronze. They live in fungus. The species is rare here.

CHŒRIDIUM.

C. histeroides *Webr.*

COPRIS.

C. minutus *Drury.*
C. anaglypticus *Say.*
C. carolina *Linn.*

PHANÆUS.

P. carnifex *Linn.*

ONTHOPHAGUS.

O. hecate *Panz.*
O. janus *Panz.*
O. orpheus *Panz.*
O. striatulus *Beauv.*
O. subæneus *Beauv.*
O. pennsylvanicus *Harold.*

ÆGIALIA.

A. conferta *Horn.*

ATÆNIUS.

A. gracilis *Melsh.*
A. stercorator *Fab.*
A. abditus *Hald.*
A. rugiceps *n. sp.*

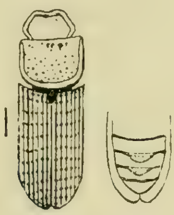
A species of *Atænius* which I have taken here I think new and propose for it the name *A. rugiceps*, and describe it as follows :

Color, brown. The thorax darker and more shining than elytra. Entire front of head rugose; posterior part with a shallow punctured transverse groove. Clypeus emarginate in front. Thorax with sparse, scattered, very coarse punctures and a shal-

Atænius rugiceps, **n. sp.**

low coarsely punctured groove, extending from base to middle. Front and hind thoracic angles prominent, sides arcuate and with a narrow margin extending across base and along sides to front angles. Elytra slightly narrower than thorax, sides straight, tips conjointly rounded. Striæ deep, impunctured, with sides of striæ feebly crenate. Abdomen with very minute punctures. Segments very prominent and rounded, sutures between them crenate. Mesosternum carinate between coxæ. Length 3-5 mm. One specimen. Cincinnati, O.

PLEUROPHORUS.



Pleurophorus ventralis **Horn.**

I took specimens of this species here in 1880, and sent them to Dr. Horn, who named it "*Atænius*, n. sp." In Monograph of the *Aphodiini*, Trans. 1887, page 92, he describes it under the above name. I have what I think to be male and female of this remarkable species.

DIALYTES.

D. striatulus *Say.*

APHODIUS.

A. fimetarius *Linn.*
A. crassulus *Horn.*
A. ruricola *Melsh.*
A. granarius *Linn.*
A. serval *Say.*
A. inquinatus *Hbst.*
A. rubeolus *Beauv.*
A. stercorosus *Melsh.*
A. lentus *Horn.*
A. terminalis *Say.*
A. bicolor *Say.*
A. femoralis *Say.*
A. oblongus *Say.*

BOLBOCERUS.

B. tumefactus *Beauv.*
B. lazarus *Fabr.*

ODONTÆUS.

O. filicornis *Say.*
O. cornigerus *Mels.*

GEOTRUPES.

G. splendidus *Fabr.*
G. semiopacus *Jeckel.*
G. blackburnii *Fabr.*
G. " var. jecklii *Horn.*

Splendidus I have only taken in fungus, the others in excrement.

CLŒOTUS.

C. aphodiodes *Ill.*
C. globosus *Say.*

NICAGUS.

N. obscurus *Lec.*

TROX.

T. scutellaris *Say.*
T. monachus *Hbst.*
T. asper *Lec.*
T. suberosus *Fabr.*
T. punctatus *Germ.*
T. tuberculatus *De G.*
T. capillaris *Say.*
T. unistriatus *Beauv.*
T. foveicollis *Harold.*
T. terrestris *Say.*
T. æqualis *Say.*
T. scaber *Linn.*

Trox are abundant on dead animal remains. I have taken *capillaris, unistriatus* and *foveicollis* on an old hide of Virginia deer.

HOPLIA.

H. debilis *Lec.*
H. modesta *Hald.*

DICHELONYCHA.

D. bivittata *Lec.*
D. testacea *Kby.*
D. fuscula *Lec.*

SERICA.

S. vespertina *Gyll.*
S. iricolor *Say.*
S. sericea *Ill.*

MACRODACTYLUS.

M. subspinosus *Fab.*
M. angustatus *Beauv.*

DIPLOTAXIS.

D. harperi *Blanch.*
D. frondicola *Say.*

LACHNOSTERNA.

L. ephelida *Say.*
L. gibbosa *Burm.*
L. fusca *Froh.*
L. " var. arcuata *Smith.*
L. " var. brevicollis *Burm.*
L. fraterna *Harr.*
L. rugosa *Mels.*
L. hirticula *Knoch.*
L. comans *Burm.*
L. villifrons *Lec.*
L. ilicis *Knoch.*
L. crenulata *Froh.*
L. quercus *Knoch.*
L. inversa *Horn.*
L. tristis *Fab.*
L. hornii *Smith.*
L. albina *Burm.*

ANOMALA.

A. binotata *Gyll.*
A. minuta *Burm.*
A. undulata *Melsh.*
A. lucicola *Fabr.*
A. marginata *Fab.*

STRIGODERMA.

S. arboricola *Fab.*

PELIDNOTA.

P. punctata *Linn.*

COTALPA.

C. lanigera *Linn.*

CYCLOCEPHALA.

C. villosa *Burm.*

CHALEPUS.

C. trachypygus *Burm.*

LIGYRUS.

L. ruginasus *Lec.*
L. relictus *Say.*
L. pyriformis *Lec.*
L. tridentatus *Say.*

XYLORYCTES.

X. satyrus *Fab.*

DYNASTES.

D. tityus *Linn.*

PHILEURUS.

P. valgus *Fabr.*

ALLORHINA.

A. nitida *Linn.*

EUPHORIA.

E. sepulchralis *Fab.*
E. inda *Linn.*
E. fulgida *Fab.*

CREMASTOCHILUS.

C. knochii *Lec.*
C. variolosus *Kby.*

OSMODERMA.

O. eremicola *Knoch.*
O. scabra *Beauv.*

GNORIMUS.

G. maculosus *Knoch.*

TRICHIUS.

T. piger *Fab.*
T. bibens *Fab.*
T. affinis *Gory.*

VALGUS.

V. canaliculatus *Fab.*
V. squamiger *Beauv.*

There is no complete monograph of the family SCARABÆIDÆ. Horn and Le Conte have excellent papers on many of the genera. These papers, which number 38 or more, have been published in Trans. Amer. Ent. Soc. from 1847 to 1880, but most of them from 1870 to 1880. In 1887 Dr. Horn revised *Lachnosterna* Trans. XIV, p. 209-296. Mr. F. Blanchard has a synopsis of *Canthon* in Trans. 1885, v. XII, p. 63. Mr. Blanchard also has a synopsis of *Geotrupes* in Psyche, 1888, v. V, p. 103. The latest paper on any N. A. Scarabæid genus is one by Mr. H. C. Fall on *Dichelonycha*, Trans. Aug., 1901, vol. XXVII, p. 277, and brings the subject down to date. The species of some of the genera are quite troublesome to separate. This is noticeably the case with *Lachnosterna, Diplotaxis*, etc. *Scarabæidæ* are, many of them abundant, some of the species alarmingly so. The larvæ of *Lachnosterna*, do great damage. The adults fly in swarms around electric lights. *L. hornii* is rare. I have taken it at light. *L. albina* is another rare species that I have found only by beating a certain haw tree (May 24) that stood in a thick woods. And though there were many other similar trees around, none of them produced any albina. *L. fusca* is our most abundant species. It is the larvæ of *Lachnosterna* that does such damage to grass lands, and lawns, by eating the roots of the grass. Large patches are killed in this way and the grass can be rolled up like a carpet, leaving the ground stripped bare. They are very difficult to combat as the larvæ are out of sight in the ground and can not easily be reached. The larvæ or "grub" of *Lachnosterna* are characteristic scarabæan larvæ and are figured in many works, such as Lugger's 5th report Entomologist of Minn., Packard

Guide to the Study of Insects, etc. The largest beetle occurring here belongs to this family. It is called *Dynastes tityus*. A fine male was taken on Eastern avenue, this city, July 1, 1900.

SPONDYLIDÆ.

PARANDRA.

P. brunnea *Fab.* P. polita *Say.*

P. brunnea is common, occurring late in summer and in fall, *polita* is very rare. I chopped three out of the heart of a large dead beech tree, 1878, August.

CERAMBYCIDÆ.

The "long-horned beetles."

A family that is numerously represented by many fine species. Some of them are very destructive to trees. The species I have seen from here are

ORTHOSOMA.

O. brunneum *Forst.*

PRIONUS.

P. laticollis *Drury.*

SPHENOSTETHUS.

S. taslei *Bates.*

ASEMUM.

A. mœstum *Hald.*

SMODICUM.

S. cucujiforme *Say.*

PHYSOCNEMUM.

P. brevilineum *Say.*

RHOPALOPUS.

R. sanguinicollis *Horn.*

HYLOTRUPES.

H. ligneus *Fab.*

PHYMATODES.

P. variabilis *Fab.* P. varius *Fab.*
P. amœnus *Say.*

CALLIDIUM.

C. antennatum *Newm.* C. ianthinum *Lec.*

DRYOBIUS.

D. sexfasciatus *Say.*

This is one of our most beautiful and graceful species. In former years it was abundant, but is now rare. Its larvæ bore in beech and maple. I have trapped them by nailing slabs of loose bark on the dead tree trunks, and visiting them every few days. Holding an inverted umbrella under the slab, to catch the beetles, when the bark was disturbed as they would drop to the ground. June and July.

CHION.

C. cinctus *Drury.*
C. cinctus var. garganicus *Fab.*

EBURIA.

E. quadrigeminata *Say.*

ROMALEUM.

R. atomarium *Drury.*

ELAPHIDION.

E. irroratum *Fab.*
E. mucronatum *Fab.*
E. incertum *Hald.*
E. villosum *Fab.*
E. parallelum *Newm.*
E. unicolor *Rand.*

TYLONOTUS.

T. bimaculatus *Hald.*

HETERACHTHES.

H. quadrimaculatus *Newm.*

PHYTON.

P. pallidum *Say.*

Beaten from dead osage orange. June.

OBRIUM.

O. rubrum *Newm.*
O. rubidum *Lec.*

Of the latter only one specimen.

MOLORCHUS.

M. bimaculatus *Say.*

CALLIMOXYS.

C. sanguinicollis *Oliv.*

RHOPALOPHORA.

R. rugicollis *Lec.*

PURPURICENUS.

P. humeralis *Fab.*
P. var. axillaris *Hald.*

BATYLE.

B. suturalis *Say*.

STENOSPHENUS.

S. notatus *Oliv.*

CYLLENE.

C. picta *Drury*. C. robiniæ *Forst.*

Look for *C. picta* on honey locust in June and July, and *C. robiniae* on golden rod in September.

PLAGIONOTUS.

P. speciosus *Say*.

ARHOPALUS.

A. fulminans *Fabr.*

XYLOTRECHUS.

X. colonus *Fab.* X. convergens *Lec.*
X. nitidus *Horn.*

X. nitidus is very rare here, three only.

NEOCLYTUS.

N. scutellaris *Oliv.* N. erythrocephalus *Fab.*

On a diseased tulip tree near my house *N. erythrocephalus* was ovipositing, Aug. 8, 1892.

CLYTANTHUS.

C. ruricola *Oliv.* C. albofasciatus *Lap.*

I beat the latter sp. from wild grape.

CYRTOPHORUS.

C. verrucosus *Oliv.*

EUDERCES.

E. picipes *Fab.*

DISTENIA.

D. undata *Oliv.*

DESMOCERUS.

D. palliatus *Forst.*

This species appears here on alder when it is in blossom.

NECYDALIS.

N. melitus *Say*.

A curious species with short wing cases. June.

ENCYCLOPS.

E. cæruleus *Say*.

CENTRODERA.

C. sublineata *Lec.*

A very rare species. I have only taken one.

TOXOTUS.

T. schaumii *Lec.*
T. cylindricollis *Say.*
T. cinnamopterus *Rand.*

ACMÆOPS.

A. bivittata *Say.*

GAUROTES.

G. cyanipennis *Say.*

BELLAMIRA.

B. scalaris *Say.*

Have taken a var. of this species jet black.

STRANGALIA.

S. famelica *Newm.*
S. acuminata *Oliv.*
S. luteicornis *Fab.*
S. bicolor *Swed.*

TYPOCERUS.

T. velutinus *Oliv.*
T. lugubris *Say.*

LEPTURA.

L. emarginata *Fab.*
L. lineola *Say.*
L. chalybæa *Hald.*
L. americana *Hald.*
L. exigua *Newm.*
L. subargentata *Kby.*
L. zebra *Oliv.*
L. rubrica *Say.*
L. proxima *Say.*
L. vittata *Germ.*
L. pubera *Say.*
L. ruficollis *Lec.*
L. sphæricollis *Say.*
L. vibex *Newm.*
L. aurata *Horn.*
L. mutabilis *Newm.*

L. emarginata. This fine large species emerges from dead beech timber in June; the holes are perfectly round and some of them one-half an inch in diameter. Many come from a single tree, yet it is very difficult to get specimens. I have only taken two, and Miss Braun two.

CYRTINUS.

C. pygmæus *Hald.*

This is the smallest of the family.

PSENOCERUS.

P. supernotatus *Say.*

MONOHAMMUS.

M. titillator *Fab.*
M. maculosus *Hald.*
M. confusor *Kby.*

DORCASCHEMA.

D. wildii *Uhler.*
D. nigrum *Say.*
D. alternatum *Say.*

The first two species occur on osage orange and mulberry. By beating the limbs into an inverted umbrella they can be secured, but *wildii* clings very tightly and the limbs must be struck very hard to disloge them. *D. nigrum* I find on hickory.

HETŒMIS.

H. cinerea *Oliv.*

GOES.

G. pulchra *Hald.*
G. oculata *Lec.*
G. debilis *Lec.*

ACANTHODERES.

A. quadrigibbus *Say.*
A. decipiens *Hald.*

LEPTOSTYLUS.

L. aculiferus *Say.*
L. commixtus *Hald.*
L. parvus *Lec.*
L. macula *Say.*

LIOPUS.

L. variegatus *Hald.*
L. alpha *Say.*
L. fascicularis *Harr.*
L. cinereus *Lec.*

L. variegatus breeds in honey locust.

DECTES.

D. spinosus *Say.*

LEPTURGES.

L. symmetricus *Hald.*
L. querci *Fitch.*
L. angulatus *Lec.*
L. facetus *Say.*
L. signatus *Lec.*
L. regularis *Lec.*

The latter is rare. I have beaten it from wild grape. The others are common and occur on honey locust.

HYPERPLATYS.

H. aspersus *Say.*
H. maculatus *Hald.*

UROGRAPHIS.

U. triangulifer *Hald.*
U. fasciatus *De G.*

The former occurs on honey locust, the latter on beech.

ACANTHOCINUS.

A. obsoletus *Oliv.*

ECYRUS.

E. dasycerus *Say.*
E. exiguus *Lec.*

EUPOGONIUS.

E. tomentosus *Hald.*
E. vestitus *Say.*
E. submarginatus *Lec.*

HIPPOPSIS.

H. lemniscata *Fab.*

SAPERDA.

S. calcarata *Say.*
S. vestita *Say.*
S. discoidea *Fab.*
S. tridentata *Oliv.*
S. lateralis *Fab.*
S. puncticollis *Say.*
S. concolor *Lec.*

S. calcarata depredates on poplars, bores holes into the Carolina poplars, causing them to break by the force of the wind. *L. tridentata* during the last four or five years has done incalculable damage in destroying the fine "white elms" (*Ulmus americana*) around this city. As *S. tridentata* has always been an abundant species here, I can not understand why it should suddenly become so destructive. Might it be due to the great destruction of woodpeckers that has been carried on here for years? I have often observed the red-headed woodpeckers (and other species) cutting out these larvæ from the trunks of the trees. *S. lateralis* occurs on hickory, *puncticollis* on Rhus.

MECAS.

M. inornata *Say.*

OBEREA.

O. tripunctata *Fab.*
O. basalis *Lec.*
O. schumii *Lec.*
O. oculata *Hald.*
O. mandarina *Fab.*
O. ruficollis *Fab.*

TETROPS.

T. jucunda *Lec.*

TETRAOPES.

T. canteriator *Drap.*
T. tetraophthalmus *Forst.*

This last is the very common "milk weed" beetle. The former is quite rare here. The best papers on the "Longicorns," is synopsis of *Cerambycidae* by Chas. W. Leng, vols. I, II, III, IV, Entomologica Americana and Bull. Brooklyn Ent. Soc., vol. VII. This work, which includes *Leptura*, was supplemented and completed in 1896 by Mr. Leng and Dr. Hamilton, Trans. XXIII, p. 101. The Le Conte and Horn papers, in which were originally given many of these synoptic tables, are now out of print and unobtainable. The "Longicorns" have always been great favorites with collectors in all parts of the world. Some of them are very beautiful in form as well as color.

CHRYSOMELIDÆ.

"Leaf Eaters."

The numerous species of this family are mostly small insects, many of them of brilliant colors and pretty ornamentation. They can be collected in great numbers with a sweeping net, and also by using an inverted umbrella. Holding it under the vegetation, which is then beaten with a stick. The literature is scattered. Crotch, Le Conte and Horn have published many papers (about 60) in proceedings, Academy Natural Sciences and Trans. Amer-Ent. Soc., of Philadelphia, from 1851 to 1880. Since then Dr. Horn has published several papers on various genera in Trans. "Studies in Chrysomelidæ," vol. XIX, p. 1; *Eumolpini,* 1892, vol. XIX, p. 195; *Galerucini,* 1893, vol. XX, p. 59; *Halticini,* 1889, vol. XVI, p. 163. Mr. Leng revised the *Donacia* Trans., 1891, XVIII, p. 159. As many species of this family play a very important part in agriculture; they have been well studied by the Economic Entomologists, and their life histories worked out, with figures of many of the species and their larvæ. This work has been published in "Insect Life," and the reports of the different state Entomologists. These reports can be obtained if applied for in time, by those interested. Our genera and species are as follows:

DONACIA.

D. æqualis *Say.*
D. rufa *Say*
D. metallica *Ahrens.*

Of the 27 N. A. species and varieties of *Donacia* given by Mr. Leng, I have only taken three. This is doubtless due to want of suitable environment, such as lakes with lily pads and other aquatic vegetation.

SYNETA.

S. ferruginea *Germ.*

LEMA.

L. collaris *Say.*
L. trilineata *Oliv.*

ANOMŒA.

A. laticlavia *Forst.*

COSCINOPTERA.

C. dominicana *Fab.*

BABIA.

B. quadriguttata *Oliv.*

SAXINIS.

S. omogera *Lac.*

CHLAMYS.

C. plicata *Fab.*

EXEMA.

E. gibber *Oliv.*

BASSAREUS.

B. formosus *Melsh.*
B. detritus *Oliv.*
B. mammifer *Newm.*
B. recurvus *Say.*
B. lativittus *Germ.*

CRYPTOCEPHALUS.

C. quadrimaculatus *Say.*
C. quadrigŭttulus *Suff.*
C. quadruplex *Newm.*
C. guttulatus *Oliv.*
C. venustus *Fab.*
C. venustus var. simplex *Hald.*
C. " var. cinctipennis *Rand.*
C. insertus *Hald.*
C. mutabilis *Melsh.*
C. badius *Suffr.*

PACHYBRACHYS.

P. viduatus *Fab.*
P. trinotatus *Mels.*
P. tridens *Melsh.*
P. luridus *Fab.*
P. atomarius *Melsh.*
P. hepaticus *Melsh.*
P. dilatatus *Suffr.*

MONACHUS.

M. ater *Hald.*
M. saponatus *Fab.*
M. seminulum *Suffr.*

DIACHUS.

D. auratus *Fab.*
D. pallidicornis *Suffr.*
D. chlorizans *Suffr.*

XANTHONIA.

X. 10-notata *Say.*
X. villosula *Melsh.*

FIDIA.

F. murina *Cr.*
F. longipes *Melsh.*

GLYPTOSCELIS.

G. barbatus *Say.*

MYOCHROUS.

M. denticollis *Say.*

CHRYSOCHUS.

C. auratus *Fab.*

TYMNES.

T. bicolor *Fab.*

TYPOPHORUS.

T. viridicyaneus *Cr.*
T. canella *Fab.*

Dr. Horn suppresses all the other species given in the check lists. Our *viridicyaneus* are green, those from Texas bright blue.

Canella varies very much, being of all shades of color from light all over, to jet black, which is the form called *aterrima.*

GRAPHOPS.

G. marcassita *Cr.* G. nebulosa *Lec.*

COLASPIS.

C. brunnea *Fab.*

RHABDOPTERUS.

R. picipes *Oliv.*

This is the form given in the check lists as *Colaspis praetexta.* See Horn's paper on *Eumolpini* before referred to.

NODONOTA.

N. tristis *Oliv.*
N. clypealis *Horn.*
N. convexa *Say.*
N. puncticollis *Lec.*

DORYPHORA.

D. clivicollis *Kby.*
D. decemlineata *Say.*
D. juncta *Germ.*

The larvæ of *D. juncta* are different looking from *decemlineata* and only found on *Physalis.* June.

CHRYSOMELA.

C. suturalis *Fab.*
C. similis *Rog.*
C. præcelsis *Rog.*
C. elegans *Oliv.*
C. scalaris *Lec.*
C. multipunctata *Say.*
C. " var. bigsbyana *Kby.*
C. multiguttata *Stahl.*

GASTROIDEA.

G. polygoni *Linn.* G. cyanea *Melsh.*

LINA.

L. lapponica *Linn.* L. scripta *Fab.*

CEROTOMA.

C. trifurcata *Forst.*

PHYLLOBROTICA.

P. discoidea *Fab.*

PHYLLECHTHRUS.

P. gentilis *Lec.*

DIABROTICA.

D. duodecimpunctata *Oliv.*
D. longicornis *Say.*
D. vittata *Fab.*

TRIRHABDA.

T. virgata *Lec.*

GALERUCELLA.

G. sexvittata *Lec.*
G. notulata *Fab.*
G. nymphææ *Linn.*
G. tuberculata *Say.*
G. decora *Say.*

GALERUCA.

G. externa *Say.*

BLEPHARIDA.

B. rhois *Forst.*

HYPOLAMPSIS.

H. pilosa *Ill.*

PHÆDROMUS.

P. paradoxus *Melsh.*

ŒDIONYCHIS.

O. gibbitarsis *Say.*
O. vians *Ill.*
O. thoracica *Fab.*
O. petaurista *Fab.*
O. thyamoides *Cr.*
O. sexmaculata *Ill.*
O. limbalis *Melsh.*

DISONYCHA.

D. pennsylvanica *Ill.*
D. caroliniana *Fab.*
D. glabrata *Fab.*
D. abbreviata *Mels.*
D. discoidea *Fab.*
D. xanthomelæna *Dahl.*
D. mellicollis *Say.*
D. collata *Fab.*

SPHÆRODERMA.

S. opima *Lec.*

HALTICA.

H. chalybea *Ill.*
H. ignita *Ill.*
H. carinata *Germ.*
H. fuscoænea *Mels.*
H. burgesi *Cr.*

TRICHALTICA.

T. scrabricula *Cr.*

ORTHALTICA.

O. copalina *Fab.*

CREPIDODERA.

C. rufipes *Linn.*
C. helxines *Linn.*
C. atriventris *Melsh.*

EPITRIX.

E. fuscula *Cr.*
E. lobata *Cr.*
E. cucumeris *Harr.*
E. parvula *Fab.*

MANTURA.

M. floridana. *Cr.*

CHÆTOCNEMA.

C. protensa *Lec.*
C. denticulata *Illig.*
C. parcepunctata *Cr.*
C. confinis *Cr.*

SYSTENA.

S. hudsonias *Forst.*
S. senilis *Say.*

APHTHONA.

A. insolita *Mels.*

PHYLLOTRETA.

P. sinuata *Steph.*
P. vittata *Fab.*
P. bipustulata *Fab.*
P. picta *Say.*

LONGITARSUS.

L. turbatus *Horn.*
L. testaceus *Mels.*
L. solidaginis *Horn.*

GLYPTINA.

G. spuria *Lec.*

DIBOLIA.

D. borealis *Chev.*

PSYLLIODES.

P. convexior *Lec.*

MICRORHOPALA.

M. porcata *Melsh.*

ODONTOTA.

O. dorsalis *Thunb.*
O. rubra *Web.*
O. nervosa *Panz.*

OCTOTOMA.

O. plicatula *Fab.*

STENISPA.

S. metallica *Fab.*

CASSIDA.

C. bivittata *Say.*

COPTOCYCLA.

C. aurichalcea *Fab.*
C. guttata *Oliv.*
C. purpurata *Boh.*
C. clavata *Fab.*

CHELYMORPHA.

C. argus *Licht.*

Octotoma plicatula is a very curious species. I have found it abundantly on the "Trumpet flower" (*Tecoma radicans*).

Coptocycla is abundant on the "wild morning glory" (*Calystegia sepium*). It is of the most beautiful golden hue, when fresh,

but when touched, begins to fade, and after death loses all of its golden color. *Microrhopala* is very rare here.

BRUCHIDÆ.

"Pod Weevels."

Some of this family do considerable damage to beans, peas, etc. Dr. Horn has a fine synopsis of the family in Trans. American Ent. Soc., 1873, vol. IV, pp. 311-342.

SPERMOPHAGUS.

S. robiniae *Sch.*

BRUCHUS.

B. pisi *Linn.*
B. mimus *Say.*
B. discoideus *Say.*
B. bivulneratus *Horn.*
B. obsoletus *Say.*
B. hibisci *Oliv.*
B. musculus *Say.*

TENEBRIONIDÆ.

"Dark ground beetles."

Of this large and varied family we have comparatively few species. Their metropolis being the semi-desert and sandy regions of the West. Dr. Horn published a monog. of the family in Trans. Amer. Philos. Soc., 1870, new series, vol. XIV, pp. 253-404, a paper now hard to get. Since then the same author and Dr. Le Conte have published synoptic tables of a number of genera in Trans. Amer. Ent. Soc., scattered from 1866 to 1880. Maj. T. L. Casey has a number of synoptic tables in the Ann. N. Y. Acad., 1890-91. Some of these treat of genera to which our local species belong.

NYCTOBATES.

N. pennsylvanicus *De G.*
N. barbatus *Knoch.*

The first occurs in great numbers under the loose bark of trees, the other is rare here, and differs in being smaller with much coarser punctures.

HAPLANDRUS.

H. femoratus *Fab.*

SCOTOBATES.

S. calcaratus *Fab.*

XYLOPINUS.

X. saperdioides *Fab.*

TENEBRIO.

T. obscurus *Fab.*
T. molitor *Linn.*
T. castaneus *Knoch.*
T. tenebrioides *Beauv.*

ADELINA.

A. pallida *Say.*

OPATRINUS.

O. notus *Say.*

TRIBOLIUM.

T. ferrugineum *Fab.*
T. confusum *Duv.*

In package of buckwheat flour I found thousands of confusum and its larvæ, Sep.

DIŒDUS.

D. punctatus *Lec.*

ECHOCERUS.

E. maxillosus *Fab.*

ALPHITOBIUS.

A. diaperinus *Panz.*

THARSUS.

T. seditiosus *Lec.*

ULOMA.

U. impressa *Melsh.*
U. imberbis *Lec.*

EUTOCHIA.

E. picea *Melsh.*

ANÆDUS.

A. brunneus *Ziegl.*

PARATENETUS.

P. punctatus *Sol.*
P. fuscus *Lec.*

PRATÆUS.

P. fuscula *Lec.*

DIAPERIS.

D. hydni *Fab.*

HOPLOCEPHALA.

H. bicornis *Oliv.*

PLATYDEMA.

P. excavatum *Say.*
P. ruficornis *Sturm.*
P. flavipes *Fab.*
P. ellipticum *Fab.*
P. picilabrum *Melsh.*
P. subcostatum *Lap.*

PHYLETHUS.

P. bifasciatus *Say.*

HYPOPHLŒUS.

H. thoracicus *Melsh.* H. parallelus *Melsh.*

H. thoracicus was emerging from dead beech October 3, 1900. I have taken here a *Hypophlœus* which is new, and for which I propose the name *Hypophlœus rugosus.* I took the species years ago and gave specimens to Drs. Horn and Le Conte, who then pronounced it new. I have not heard that it has been described. Its characters are as follows:

Hypophlœus rugosus **n. sp.**

Dark brown, subshining, linear. Thorax slightly longer than wide, squarely truncate in front and behind, sides arcuate, angles obtuse, coarsely punctured. Interstices forming longitudinal rugæ more evident in front and at sides. Elytra conjointly rounded at tip,obsoletely striate and densely punctate, punctures finer than those of thorax. Head evenly and finely puntured with a shallow constriction behind the eyes, which are very prominent. Antennæ (including four-jointed club), ten-jointed. Length, 3.8 mm. Eight specimens. Cincinnati, Ohio.

PENTAPHYLLUS.

P. pallidus *Lec.*

BOLITOTHERUS.

B. bifurcus *Fab.*

BOLETOPHAGUS.

B. corticola *Say.*

HELOPS.

H. micans *Fab.* H. cisteloides *Germ.*

MERACANTHA.

M. contracta *Beauv.*

STRONGYLIUM.

S. terminatum *Say*. S. crenatum *Makl.*

Crenatum is a rare and beautiful species. I have beaten specimens from the dead branches of Haw tree, June 22, 1900, and June 26, 1901.

CISTELIDÆ.

Maj. Casey has published a synopsis of this family in annals of N. Y. Acad. Sciences, 1891, vol. VI, pp. 69-170.

ALLECULA.

A. nigrans *Melsh.*

HYMENORUS.

H. obscurus *Say*.
H. niger *Mels.*
H. rufipes *Lec.*
H. humeralis *Lec.*
H. difficilis *Casey*.

CISTELA.

C. brevis *Say*.
C. ámœna *Say*.

ISOMIRA.

I. quadristriata *Coup.*
I. valida *Sz.*
I. ruficollis *Ham.*

MYCETOCHARA.

M. haldemani *Lec.*
M. fraterna *Say*.
M. foveata *Lec.*
M. gilvipes *Csy.*
M. megalops *Csy.*
M. tenuis *Lec.*
M. marginata *Lec.*
M. binotata *Say*.
M. gracilis *Lec.*
M. laticollis *Lec.*

This was once a very rich locality for *Mycetochara*. I found them in numbers on the trunks of dead trees. They are brittle insects, breaking easily when handled. To get them perfect, they should be picked up gently, not an easy thing to do, as they run so rapidly and are not easily caught. They feed on fungus. I have a species which I believe to be new and for which I propose the name:

Mycetochara horni **n. sp.**

Color testaceus, head and thorax darker. Legs paler. Anterior coxæ very large and approximate. Elytra slightly wider behind

from middle. Separately rounded at tips. Striae moderately deep, punctured and clothed with sparse, long, yellow, recumbent hairs. Thorax wider than long, narrower than elytra at humeri, broadly rounded in front, explanate at sides from apex to base, more broadly at hind angles, which are obtusely rounded. Base almost squarely truncate, disk with a broad shallow grove from base to apex. Punctures rather coarser than those of elytra. Head still more coarsely and deeply punctured. Eyes very large and prominent, as large or larger in proportion than those of *megalops* Casey, separated by the width of their narrowest diameter. Body below rather coarsely and sparsely punctured. A large species, as large or larger than the largest *binotata*. Length 7.8 mm. Cincinnati, Ohio. I have seen two specimens. In looking at it years ago Dr. Horn thought it new, and I have not seen any description of it, so I dedicate it to him.

CAPNOCHROA.

C. fuliginosa *Melsh.*

ANDROCHIRUS.

A. fuscipes *Melsh.*
A. femoralis *Oliv.*
A. erythropus *Kby.*

LAGRIIDÆ.

ARTHROMACRA.

A. ænea *Say.*

STATIRA.

S. splendens *Melsh.*
S. gagatina *Melsh.*

Dr. Horn has a synopsis of this family. Trans. 1888, vol. xv, p. 28. I find them by beating vegetation into an inverted umbrella. May and June.

MELANDRYIDÆ.

TETRATOMA.

T. truncorum *Lec.*
T. tessellata *Melsh.*

PENTHE.

P. obliquata *Fab.*
P. pimelia *Fab.*

P. obliquata differs from the other by having the scutellum covered with orange colored hairs.

SYNCHROA.

S. punctata *Newm.*

MALLODRYA.

M. subænea *Horn.*

I discovered this new genus here in 1887. Dr. Horn described

it in Trans. April, 1888, vol. xv., p. 42. I beat the specimens, which were then abundant, from the branches of dead "honey locust."

MELANDRYA.

M. striata *Say.*

SPILOTUS.

S. quadripustulosus *Mels.*

ENCHODES.

E. sericeus *Hald.*

MYSTAXUS.

M. simulator *Newm.*

HYPULUS.

H. lituratus *Say.*
H. vandoueri *Muls.*
H. concolor *Lec.*

SYMPHORA.

S. flavicollis *Hald.*
S. rugosa *Hald.*

EUSTROPHUS.

E. repandus *Horn.*
E. bicolor *Say.*
E. tomentosus *Say.*

HOLOSTROPHUS.

H. bifasciatus *Say.*

HALLOMENUS.

H. scapularis *Melsh.*

ORCHESIA.

O. castanea *Mels.*
O. gracilis *Muls.*

CANIFA.

C. plagiata *Melsh.*
C. pusilla *Hald.*
C. pallipes *Melsh.*

NOTHUS.

N. varians *Lec.*

LACCONOTUS.

L. punctatus *Lec.*

Dr. Horn has published synopses of *Hypulus, Eustrophus, Holostrophus* and *Orchesia* in Trans., 1888, vol. xv. He gave *Mycterus* and *Lacconotus* in same publication in 1879 (vol. 7). Le Conte published syn. of *Hallomenus* in Proc. Amer. Philos. Soc., 1878, vol. 17, p. 619.

PYTHIDÆ.

PYTHO.

P. americanus *Kby.*

Only this one species of this family has been taken here, and that years ago.

ŒDEMERIDÆ.

MICROTONUS.

M. sericans *Lec.*

NACERDES.

N. melanura *Linn.*

OXACIS.

O. cana *Lec.*

ASCLERA.

A. ruficollis *Say.*

A. puncticollis *Say.*

MORDELLIDÆ.

In this journal, October, '92, p. 123, I published a paper enumerating 53 species found here. Since then a few additions have been made. The locality is very rich in the family. The synopsis by John B. Smith (Trans. Amer. Ent. Soc., July, 1882) is the latest and best on the subject.

PENTARIA.

P. trifasciata *Mels.*

TOMOXIA.

T. bidentata *Say.*

T. linella *Lec.*

T. hilaris *Say.*

MORDELLA.

M. borealis *Lec.*

M. malæna *Germ.*

M. scutellaris *Fab.*

M. octopunctata *Fab.*

M. marginata *Melsh.*

M. lunulata *Hel.*

M. serval *Say.*

M. oculata *Say.*

M. triloba *Say.*

M. undulata *Mels.*

M. discoidea *Mels.*

GLIPODES.

G. sericans *Mels.*

MORDELLISTENA.

M. bicinctella *Lec.*

M. arida *Lec.*

M. lutea *Melsh.*

M. varians *Lec.*

M. gramica *Lec.*

M. ustulata *Lec.*

M. trifasciata *Say.*
M. lepidula *Say.*
M. limbalis *Melsh.*
M. biplagiata *Helm.*
M. vilis *Lec.*
M. vapida *Lec.*
M. decorella *Lec.*
M. bipustulata *Hel.*
M. picipennis *Smith.*
M. fulvicollis *Melsh.*
M. militaris *Lec.*
M. comata *Lec.*
M. aspersa *Mels.*
M. tosta *Lec.*
M. amica *Lec.*
M. picilabris *Hel.*
M. infima *Lec.*
M. semiusta *Say.*
M. nigricans *Mels.*
M. pustulata *Mels.*
M. convicta *Lec.*
M. splendens *Smith.*
M. morula *Lec.*
M. ambusta *Lec.*
M. singularis *Smith.*
M. unicolor *Lec.*
M. marginalis *Say.*
M. pubescens *Fab.*
M. bihamata *Mels.*
M. liturata *Mels.*
M. fuscata *Mels.*
M. suturella *Helm.*
M. attenuata *Say.*
M. discolor *Mels.*

Among the unidentified species I have taken here, two are so distinct that I describe them as new, and characterize them as follows:

Mordellistena sexnotata, **n. sp.**

Brownish yellow, sparsely covered with coarse hairs, which are finer and more sparse on head. Humeri each with a very dark brown spot. Another in middle of elytra, beginning at base surrounding scutellum and extending backward in triangular shape about one third the length. A large nearly round spot on each elytron at middle, but not attaining suture. And a sixth spot or band across the elytra at posterior fourth, not attaining the tip. A fain darker spot on disk of thorax. Tibia with three oblique black ridges, the one nearest the tip being shorter. First joint of tarsi with two, second with one. Legs all pale, length 3 mm. One specimen Ky. opp. Cin., O.

Mordellistena smithi, **n. sp.**

Piceus black. Anterior and middle legs testaceus. Elytra rufo piceous with lighter red splotches on humeri extending obliquely backward toward the suture. The amount of red varies, in some specimens being more extended. Pubescence coarse, yellow. Hind tibia with three, 1st tarsal joint with three, 2d with one, well defined ridges. Length, 3.5 mm. 14 specimens, Cincinnati, O. To my old friend, Prof. John B. Smith, of New Jersey, this species is dedicated. His excellent paper on the family (Trans., July, 1882, p. 73) was the inspiration that started me into a study of this interesting family. I have a number of *Mordellistena* that are perhaps also new, which I have reserved for future study.

ANTHICIDÆ.

EURYGENIUS.

E. wildii *Lec.*

STEREOPALPUS.

S. mellyi *Laf.*

CORPHYRA.

C. canaliculata *Lec.*
C. terminalis *Say.*
C. fulvipes *Newm.*
C. pulchra *Lec.*
C. labiata *Say.*
C. lugubris *Say.*

Corphyra labiata was an abundant species during May and June. Found on tall "horse weeds" (*Ambrosia trifida*) growing in river bottoms. Associated with them, but very much less abundant, was the form described as *C. pulchra* by Le Conte. This seems to be a mere variety of *C. labiata* having the legs pale. In a large series they average the same size. *C. lugubris* is an abundant species (May-June). *C. fulvipes,* seems to be a variety of *C. lugubris* having the legs pale. It is less abundant than *lugubris.* Of *C. terminalis Say.* Dr. Horn says, Trans., 1871, p.

282: "Yellow space at apex of elytra not impressed." In a large series of males, I start with the typical male form as defined above. Then one with the faintest trace of an impression, and so on, more and more defined, until one is reached with a well defined impression, close to the suture but not attaining apical angle. When Le Conte described *C. canaliculata,* Smith. Mis. Collections, pt. 1, p. 143, only a single one (type) was known. During 1880, I collected hundreds on the blossoms of "white thorn" and "buckeye," but all were females. They varied from the type in color as follows: Thorax rufous, elytra black, and legs black. The legs in the type were pale, thorax and elytra black, legs pale, and black all over. Surely if *C. pulchra* and *fulvipes* are good species, several could be made of *canaliculata.* Since 1880 I have secured several males. They have the apices of elytra broadly tipped with pale. Why the males should be so extremely rare, I do not know. At certain "haw" trees when in blossom, by holding my umbrella inverted under the branches and striking them a hard blow with a stick, *Corphyra* would shower down, hundreds to a tree, and yet the larvæ are to me absolutely unknown, nor have I the slightest idea where to look for them.

XYLOPHILUS.

X. basilis *Lec.*
X. nebulosus *Lec.*
X. fasciatus *Mels.*
X. piceus *Lec.*

MACRATRIA.

M. murina *Fab.*

NOTOXUS.

N. bicolor *Say.*
N. bifasciatus *Lec.*
N. monodon *Fabr.*
N. anchora *Hentz.*

TOMODERUS.

T. constrictus *Say.*

DILANDIUS.

D. myrmecops *Csy.*

I took this singular species from under a flat stone, Nov. 17.

ANTHICUS.

A. obscurus *Laf.*
A. sturmii *Laf.*
A. formicarius *Laf.*
A. cinctus *Say.*
A. floralis *Payk.*
A. cervinus *Laf.*
A. pubescens *Lec.*

The synopsis by Le Conte, Proc. Acad. Nat. Science of Phil., vol. 6, p. 9, is very old, being publishing in 1852, since then Dr. Horn has published good synopsis of *Corphyra* and *Notoxus* Trans., vol. x, 1883. Maj. Casey has paper on *Anthicidæ,* Col. notices in Annals of N. Y. Acad. Sciences, VIII, p. 624.

PYROCHROIDÆ.

PYROCHROA.

P. flabellata *Fab.* P. femoralis *Lec.*

DENDROIDES.

D. bicolor *Newm.* D. concolor *Newm.*

Le Conte published synopsis in 1855, Proc. Acad., vol. 7, p. 274.

MELOIDÆ.

"Blister Beetles."

This family is not very abundant here. Le Conte published synopsis in 1853, vol. 6, p. 328-350. *Macrobasis* and *Epicauta* were treated by Horn in 1873, Proc. Am. Philos. Soc., vol. 13.

MELOE.

M. impressus *Kby.*

TRICRANIA.

T. sanguinipennis *Say.*

March 22, 1896, I took 7 of this species crawling on "sorrel," *Rumex.*

ZONITIS.

Z. bilineata *Say.*

MACROBASIS.

M. unicolor *Kby.* M. immaculata *Say.*

EPICAUTA.

E. vittata *Fab.* E. pennsylvanica *De G.*
E. cinerea *Forst.*

POMPHOPŒA.

P. ænea *Say.*

April 27, 1891, I took a fine male and female of this species from the throat of a kingbird I had shot for preservation.

RHIPIPHORIDÆ.

PELECOTOMA.

P. flavipes *Melsh.*

But one specimen of this species in many years.

RHIPIPHORUS.

R. dimidiatus *Fab.* R. limbatus *Fab.*
R. cruentus *Germ.*

I find these three species in the fall on flowers.

MYODITES.

M. fasciatus *Say*.

Myodites are found on blossoms but they take flight so quickly when alarmed, that they are quite difficult to catch.

STYLOPIDÆ.

XENOS.

X. peckii *Kby*.

A very curious genus that is parasitic in the bodies of wasps. During 1900 and 1901 I captured a number of wasps that were infected with these very interesting little creatures. The figures given in Packard's Guide to the Study of Insects, p. 482-483, for *Stylops childreni* are exactly those of *Xenos peckii* as I have been able to identify the species. Our talented and lamented friend, H. G. Hubbard, has given a most interesting account of the rearing of *Xenos* from a colony of wasps in Fla. See Can. Entomologist, Oct., 1892, p. 259. I have one of these specimens and it only differs from mine in being of a pale color, mine being sooty black. I have hatched *Xenos* from the following wasps, viz.: *Ammophila urnaria, Polistes fuscatus, Prionyx atrata, Sphex ichneumonea, Odynerus molestus.*

I have pinned in my box with *Xenos* the following host wasps, viz.:

Poslistes 5, *Prionyx* 3, *Ammophila* 2, *Sphex* and *Odynerus* one each. And this is about the proportion in which I found they were infected. I confined the infected wasps in tumbler with false bottom of screen wire, first putting in bit of blotter to absorb moisture that might run down. I fed the wasps jelly and water, which they greedily ate, first convincing themselves that they could not escape. Stylopized individuals appeared during June, July, August, September and October. Most of the male *Xenos* were hatched in August. Several wasps died before the beetles hatched. From one of these I hatched the beetle after the wasp had been dead two days; from another dead wasp containing only female *Xenos*, a lot of the minute larvæ hatched and crawled out on the tips of the hairs of the wasp and died there. The activity of the male *Xenos*, so well described by Mr. Hubbard in the article above referred to, is simply astonishing, and it is no wonder that the creature wears itself out and dies in 20 or 30 minutes. If the wasp can catch the *Xenos* she makes short work of it. In trying to take out of tumbler a male *Xenos* I allowed it to escape and it darted away like a flash. The *Xenos* when hatched is jet, opaque black, the fan-like wings when fresh have a beautiful mother of pearl iridescent tinge. The body is very flexible and

they keep twisting and writhing it about. How union of the sexes is effected I have so far been unable to find out. Though if the end of the female that projects is the end that receives the male, then the operation would be considerably simplified.

The remaining families are called "Snout Beetles" and "Weevils." Most of them have the head prolonged into a snout or proboscis.

RHYNCHITIDÆ.

EUGNAMPTUS.

E. angustatus *Hbst.*

E. collaris *Fab.*

RHYNCHITES.

R. hirtus *Fab.*

ATTELABIDÆ.

ATTELABUS.

A. bipustulatus *Fab.*

OTIORHYNCHIDÆ.

HORMORUS.

H. undulatus *Uhler.*

AMNESIA.

A. grisea *Horn.*

PANSCOPUS.

P. erinaceus *Say.*

PHYXELIS.

P. rigidus *Say.*

CERCOPEUS.

C. chrysorrhaeus *Say.*

TANYMECUS.

T. confertus *Gyll.*

PANDELETEJUS.

P. pilaris *Hast.*

BRACHYSTYLUS.

B. acutus *Say.*

APHRASTUS.

A. tæniatus *Say.*

CYPHOMIMUS.

C. dorsalis *Horn.*

ARACANTHUS.

A. pallidus *Say.*

SITONES.

S. flavescens *Marsh.*

CURCULIONIDÆ.

ITHYCERUS.

I. noveboracensis *Forst.*

APION.

A. cribricolle *Lec.*
A. porcatum *Boh.*

Many unidentified species.

The latest paper on *Apion* is by Mr. H. C. Fall, Trans., vol. 25, Oct., 1898, p. 105.

PHYTONOMUS.

P. punctatus *Fab.*
P. comptus *Say.*

LISTRONOTUS.

L. tuberosus *Lec.*
L. squamiger *Say.*
L. inæqualipennis *Boh.*
L. sulcirostris *Lec.*
L. latiusculus *Boh.*
L. caudatus *Say.*

Many unnamed species.

MACROPS.

M. spurcus *Boh.*
M. solutus *Boh.*

Many unnamed species.

LIXUS.

L. punctinasus *Lec.*
L. terminalis *Lec.*
L. concavus *Say.*
L. amplexus *Casey.*

DORYTOMUS.

D. mucidus *Say.*
D. brevicollis *Lec.*

BARYTYCHIUS.

B. amœnus *Say.*

SMICRONYX.

S. ovipennis *Lec.*
S. flavicans *Lec.*
S. tychoides *Lec.*
S. vestitus *Lec.*
S. corniculatus *Fab.*

ONYCHYLIS.

O. nigrirostris *Boh.*

LISSORHOPTRUS.

L. simplex *Say.*

BAGOUS.

B. sellatus *Lec.*
B. magister *Lec.*
B. restrictus *Lec.*
B. mammillatus *Say.*

OTIDOCEPHALUS.

O. myrmex *Hbst.*
O. chevrolatii *Horn.*
O. lævicollis *Horn.*
O. perforatus *Horn.*

The last named is rare, the others common. *Perforatus* may be known from the others, by its brown color, the others are shining black; good anatomical characters, however, separate them. See Horn's Synopsis, Proc. Amer. Philos. Soc., 1873, vol. 13, p. 448.

MAGDALIS.

M. lecontei *Horn.*
M. barbita *Say.*
M. pandura *Say.*
M. armicollis *Say.*
M. pallida *Say.*

COCCOTORUS.

C. scutellaris *Lec.*

ANTHONOMUS.

A. quadrigibbus *Say.*
A. nebulosus *Lec.*
A. profundus *Lec.*
A. scutellatus *Gyll.*
A. signatus *Say.*
A. suturalis *Lec.*
A. corvulus *Lec.*
A. cratægi *Walsh.*
A. mixtus *Lec.*
A. validus *Dtz.*

ORCHESTES.

O. pallicornis *Say.*
O. canus *Horn.*
O. niger *Horn.*
O. ephippiatus *Say.*

ELLESCHUS.

E. ephippiatus *Say.*

PRIONOMERUS.

P. calceatus *Say.*

PIAZORHINUS.

P. scutellaris *Say.*

THYSANOCNEMIS.

T. fraxini *Lec.*
T. helvola *Lec.*

PLOCETES.

P. ulmi *Lec.*

GYMNETRON.

G. teter *Fab.*

LÆMOSACCUS.

L. plagiatus *Fab.*

CONOTRACHELUS.

C. juglandis *Lec.*
C. albicinctus *Lec.*
C. nenuphar *Hbst.*
C. seniculus *Lec.*
C. affinis *Sch.*
C. elegans *Boh.*
C. cratægi *Melsh.*
C. adspersus *Lec.*
C. posticatus *Say.*
C. geminatus *Dej.*
C. cribricollis *Say.*
C. tuberosus *Lec.*
C. anaglypticus *Say.*
C. erinaceus *Lec.*

RYSSEMATUS.

R. palmacollis *Say.*
R. æqualis *Horn.*
R. annectens *Casey.*

The last species I found eating out the heads of the "swamp mild weed" (*Asclepias incarnata*) growing on the border of ponds, May 24. It was abundant.

ZAGLYPTUS.

Z. sulcatus *Lec.*
Z. striatus *Lec.*

Sulcatus is abundant, *striatus* is rare. It has been suggested to me that they were sexes of each other, but I am convinced they are distinct, as I have found both species paired.

MICROHYUS.

M. setiger *Lec.*

ACAMPTUS.

A. rigidus *Lec.*
A. echinus *Lec.*

ACALLES.

A. carinatus *Lec.*
A. sordidus *Lec.*
A. clavatus *Say.*

CANISTES.

C. schusteri *Casey.*

TYLODERMA.

T. foveolatum *Say.*
T. nigrum *Casey.*
T. æreum *Say.*
T. fragariæ *Riley.*
T. variegatum *Horn.*

PSOMUS.

P. politus *Casey.*

PHYRDENUS.

P. undatus *Lec.*

CRYPTORHYNCHUS.

C. parochus *Hbst.*
C. bisignatus *Say.*
C. fuscatus *Lec.*
C. obtentus *Hbst.*
C. fallax *Lec.*
C. minutissimus *Lec.*
C. ferratus *Say.*

PIAZURUS.

P. oculatus *Say.*

COPTURUS.

C. quercus *Say.*
C. binotatus *Lec.*

ACOPTUS.

A. suturalis *Lec.*

TACHYGONUS.

T. tardipes *Lec.*

I have taken this very curious little beetle by beating white elm (*Ulmus americana*) into an inverted umbrella, June 19.

CRAPONIUS.

G. inæqualis *Say.*

CŒLIODES.

C. curtus *Gyll.*
C. asper *Lec.*
C. flavicaudis *Boh.*
C. acephalus *Say.*
C. nebulosus *Lec.*

CEUTORHYNCHUS.

C. rapæ *Gyll.*
C. sulcipennis *Lec.*
C. septentrionalis *Gyll.*
C. zimmermani *Gyll.*
C. erysimi *Fab.*

This last species I never observed here until 1892.

PELENOMUS.

P. sulcicollis *Fab.*

CŒLOGASTER.

C. zimmermani *Gyll.*

RHINONCUS.

R. percarpius *Linn.*
R. pyrrhopus *Lec.*
R. longulus Lec.

BARIS.

B. umbilicata *Lec.*
B. transversa *Say.*
B. tumescens *Lec.*
B. ærea *Boh.*

TRICHOBARIS.

T. trinotata *Say.*

PSEUDOBARIS.

P. angusta *Lec.*

GLYPTOBARIS.

G. rugicollis *Lec.*

AULOBARIS.

A. scolopax *Say.*

AMPELOGLYPTER.

A. sesostris *Lec.*
A. ater *Lec.*

MADARUS.

M. undulatus *Say.*

STETHOBARIS.

S. tubulatus *Say.*

CENTRINUS.

C. scutellum-album *Say.*
C. strigicollis *Casey.*
C. striatirostris *Lec.*
C. modestus *Boh.*
C. confusus *Boh.*
C. prolixus *Lec.*
C. perscitus *Hbst.*
C. picumnus *Hbst.*

LIMNOBARIS.

L. calva *Lec.*
L. rectirostris *Lec.*
L. punctifer *Casey.*

ZYGOBARIS.

T. subcalva *Lec.*

BARINUS.

B. cribricollis *Lec.*

EUCHÆTES.

E. echidna *Lec.*

This curious little porcupine weevil was in clusters on trunk of a dead beech tree, Sept. 27, 1900. I took one cluster of 30. They very closely resemble the color of the bark.

PLOCAMUS.

P. hispidulus *Lec.*

BALANINUS.

B. nasicus *Say.*
B. caryæ *Horn.*
B. quercus *Horn.*
B. uniformis *Lec.*

BRENTHIDÆ.

EUPSALIS.

E. minuta *Drury.*

This is the only representative we have here of the array of strange looking elongate forms that are found in tropical countries. We have in the extreme South and S. West three species

of *Brenthus*. *Eupsalis* lives under bark. I have found many under the bark of a buckeye tree. The male has the mouth parts shaped like pincers, quite different from the straight beak of the female.

CALANDRIDÆ.

RHODOBÆNUS.

R. tredecimpunctatus *Ill.*

SPHENOPHORUS.

S. zeæ *Walsh.*
S. melanocephalus *Fabr.*
S. sayi *Gyll.*
S. callosus *Oliv.*
S. parvulus *Gyll.*

CALANDRA.

C. oryzae *Linn.*
C. granaria *Fab.*
C. remotepunctata *Gyll.*

DRYOPHTHORUS.

D. americanus *Bedel.*

DRYOTRIBUS.

D. mimeticus *Horn.*

TYPHLOGLYMMA.

T. puteolatum *Dury.*

This was described by me in this journal, March 27, 1901.

HIMATIUM.

H. errans *Lec.*

COSSONUS.

C. platalea *Say.*
C. concinnus *Boh.*
C. corticola *Say.*
C. several unnamed species.

ALLOMIMUS.

A. dubius *Horn.*

STENOMIMUS.

S. pallidus *Boh.*

WOLLASTONIA.

W. quercicola *Boh.*

AMAURORHINUS.

A. nitens *Horn.*

PHLŒOPHAGUS.

P. minor *Horn.*

STENOSCELIS.

S. brevis *Boh.*

SCOLYTIDÆ.

A large family, some of them very destructive to timber.

PLATYPUS.

P. compositus *Say*.

MONARTHRUM.

M. fasciatum *Say*. M. mali *Fitch*.

PITYOPHTHORUS.

P. pullus *Zimm*.

HYPOTHENEMUS.

H. eruditus *West*.

XYLOTERUS.

X. politus *Say*.

XYLEBORUS.

X. celsus *Eich*. X. pubescens *Zimm*.
X. xylographus *Say*. X. cælatus *Eich*.

TOMICUS.

T. calligraphus *Germ*.

MICRACIS.

M. rudis *Lec*.

THYSANOES.

T. fimbricornis *Lec*.

SCOLYTUS.

S. quadrispinosus *Say*. S. rugulosus *Ritz*.
S. muticus *Say*.

CHRAMESUS.

C. icoriæ *Lec*.

PHLŒOTRIBUS.

P. liminaris *Harris*. P. frontalis *Oliv*.

P. liminaris has been taken on the "bladder nut" (*Staphylea trifoliata*) by Prof. Hine.

CNESINUS.

C. strigicollis *Lec*.

DENDROCTONUS.

D. terebrans *Lec*.

CRYPTURGUS.

C. atomus *Lec*.

HYLESINUS.

H. aculeatus *Say*.
H. fasciatus *Say*.
H. sericeus *Mann.*

HYLASTES.

H. rufipes *Eich.*

H. rufipes is the same as *Hylesinus opaculus* of the check list. See Proc. Nat. Musuem, vol. 18, p. 605.

ANTHRIBIDÆ.

EURYMYCTER.

E. fasciatus *Oliv.*

TROPIDERES.

T. bimaculatus *Oliv.*
T. rectus *Lec.*

ALLANDRUS.

A. bifasciatus *Lec.*

HORMISCUS.

H. saltator *Lec.*

TOXOTROPIS.

T. pusillus *Lec.*

EUSPHYRUS.

E. walshii *Lec.*

I have taken these last three species on osage orange.

PIEZOCORYNUS.

P. dispar *Gyll.*
P. mixtus *Lec.*

ANTHRIBUS.

A. cornutus *Say.*

CRATOPARIS.

C. lunatus *Fab.*

BRACHYTARSUS.

B. alternatus *Say.*
B. variegatus *Say.*
B. tomentosus *Say.*

ARÆOCERUS.

A. fasciculatus *De G.*

Found in coffee berries.

CHORAGUS.

C. sayii *Lec.*

Several unidentified species of *Scolytids* and *Anthribids* probably new.

INDEX.

ARTICLE VI.—CHECK LIST OF HAMILTON COUNTY, OHIO, PLANTS, EXCLUSIVE OF THE LOWER CRYPTOGAMS.

By Walter H. Aiken.

Hamilton County in area is one of the smaller counties of the State of Ohio. It includes about three hundred and ninety square miles. The county is remarkably well watered and fertile. The underlying rocks of the Miami country are calcareous, and even the drift gravels are usually composed largely of limestone. From both of these sources fertilizing elements are imparted to the soil.

The low water in the Ohio River at Cincinnati is 431.96 feet above the mean tide at Sandy Hook, and the hills on the Ohio side (Walnut Hills, College Hill, and Price Hill) rise from 450 to 470 feet above the river.

The latitude of Cincinnati (the old Observatory) is 39° 6′ 26″ N., its longitude 84° 28′ W.

The surface of the county is drained by many small rivers and streams, the principal being the Big Miami, Little Miami, Dry Fork of Whitewater, Mill Creek, Duck Creek, Taylor Creek, and Blue Rock Creek.

North of the present city limits is a spacious basin or amphitheater of about twenty-five square miles, into which the suburbs are fast extending. As the city and its suburbs are thus expanding, the ponds and morasses of years ago are fast disappearing, and a great change in the flora of this region has resulted.

The climate of the county is mild and genial. The average mean temperature of the year is 52.5° Fht. The average annual rainfall in the last thirty-three years has been 38.36 inches.

In the following check list many new accessions to the Cincinnati Flora will be noticed, largely attributable to the numerous railways which center here from all parts of the continent, and possibly to the accidental importation of seeds of weeds mixed in among the seeds of foreign garden plants.

Many cultivated plants from public parks and private gardens have been added to the list, because such plants are frequently brought into the class-rooms of our schools as material for study. All the species enumerated, not considered to be natives of the region, have their respective native countries indicated.

The following sources have been consulted in compiling the catalogue, viz.:

1.— Synopsis of the Flora of the Western States. By John L. Riddell. (1835.)

2.— Catalogue of Plants, native and naturalized, collected in the vicinity of Cincinnati, Ohio, during the years 1834–1844. By Thos. G. Lea. (1849.)

3.— Catalogue of Flowering Plants and Ferns observed in the vicinity of Cincinnati. By Joseph Clark. Addenda by Robert Buchanan. (1852.)

4.— Catalogue of the Flowering Plants, Ferns, and Fungi growing in the vicinity of Cincinnati. By Joseph F. James. (1879.)

5.—Additions and Corrections to the Catalogue of Joseph F. James. By Davis L. James. (1881.)

6.— List of Plants observed growing wild in the vicinity of Cincinnati, Ohio. By C. G. Lloyd. (1891.)

7.— Catalogue of Ohio Plants. By Professor W. A. Kellerman and Wm. C. Werner, of Ohio State University. Vol. VII, Ohio Geological Reports. (1893.)

8.—My own private collection of upward of 800 Phaenogamous Plants, gathered in the vicinity of Cincinnati since 1895.

9.—The private collection of Miss Lucy Braun, gathered in 1903, which collection contains many species rare in this locality, and is especially rich in the river flora.

10.— The author has also had the privilege of examining many hundred of the collections of the pupils of the Cincinnati High Schools during the past years, covering very fully our Spring Flora.

CHECK LIST.

1904.

OPHIOGLOSSACEAE

Botrychium
MOONWORT.
dissectum Spreng.
obliquum Muhl.
Virginianum (L.) Sw.

Ophioglossum
ADDER'S TONGUE.
vulgatum L. N. U. S.

OSMUNDACEAE

Osmunda
FLOWERING FERN.
cinnamomea L.
Claytoniana L.
regalis L.

POLYPODIACEAE

Filix
(*Cystopteris*)
BLADDER FERN.
bulbifera (L.) Underw.
fragilis (L.) Underw.

Onoclea
sensibilis L.

Dryopteris
(*Aspidium* in part)
SHIELD FERN.
Goldieana (Hook.) A. Gray
N. E. U. S.
marginalis (L.) A. Gray
Noveboracensis (L.) A. Gray
spinulosa intermedia (Muhl.)
Underw. N. U. S.
Thelypteris (L.) A. Gray.

Phegopteris
BEECH FERN.
hexagonoptera (Michx.) Fee
Phegopteris (L.) Underw.
(*P. polypodioides* Fee)

Polystichum
(*Aspidium* in part)
acrostichoides (Michx.) Schott

Camptosorus
WALKING LEAF.
rhizophyllus (L.) Link

Asplenium
SPLEENWORT.
acrostichoides Sw.
(*A. thelypteroides* Michx.)
N. E. U. S.
angustifolium Michx.
Filix-foemina (L.) Bernh.
platyneuron (L.) Oakes
(*A. ebeneum* Ait.)
Trichomanes L.

Adiantum
MAIDEN HAIR FERN.
pedatum L.

Pteridium
(*Pteris* in part)
BRAKE.
aquilinum (L.) Kuhn

Polypodium
POLYPODY.
polypodioides (L.) A. S. Hitche
(*P. incanum* Sw.)

SALVINIACEAE

Azolla
Caroliniana Willd.

EQUISETACEAE

Equisetum

Horsetail.

arvense L. N. U. S.
fluviatile L.
(*E. limosum* L.) N. U. S.
hyemale L.
sylvaticum L.

TAXACEAE

Taxus

Yew.

minor (Michx.) Britton
(*T. Canadensis* Willd.) N. U. S.

Ginko

Maiden-Hair Tree.

biloba L. China.

PINACEAE

Pinus

White Pine.

Strobus L. N. E. U. S.

Larix

Larch.

laricina (Du Roi) Koch.
(*L. Americana* Michx.)
N. E. U. S.

Thuja

Arbor Vitae.

occidentalis L. N. E. U. S.

Juniperus

Juniper, Red Cedar.

Virginiana L.

TYPHACEAE

Typha

Cat-tail.

latifolia L.

SPARGANIACEAE

Sparganium

Bur-reed.

androcladum (Engelm.) Morong

POTAMOGETONACEAE

Potamogeton

Pond-Weed.

foliosus Raf.
(*P. pauciflorus* Purch)
natans L.
pectinatus L.

Zannichellia

Horned Pond-Weed.

palustris L.

ALISMACEAE

Alisma

Water Plantain.

Plantago-aquatica L.

Sagittaria

Arrow-Head.

latifolia Willd.
(*S. variabilis* Engelm.)

HYDROCHARIDACEAE

Philotria

(*Elodea*)

Canadensis (Michx.) Britton

GRAMINEAE

Andropogon

Beard Grass.

furcatus Muhl.
scoparius Michx.
Virginicus L.

Sorghum

Halepense (L.) Pers. Asia

Chrysopogon

avenaceus (Michx.) Benth.

Paspalum

laeve Michx.
setaceum Michx.

Panicum

Witch Grass.

capillare L.
clandestinum L.
depauperatum Muhl.
dichotomum L.
linearifolium Scribn.
Porterianum Nash.
proliferum Lam.
virgatum L.

Echinochloa
(*Panicum* in part)
Crus-galli (L.) Beauv. Europe.

Syntherisma
(*Panicum* in part)
CRAB OR FINGER GRASS.
sanguinalis (L.) Dulac. Europe.

Chaetochloa
(*Setaria*, also *Ixophorus*, Nash)
BRISTLY FOXTAIL GRASS.
glauca (L.) Scribn.
FOXTAIL PIGEON GRASS. Europe
Italica (L.) Scribn. Europe.
verticillata (L.) Scribn. Europe.
viridis (L.) Scribn.
GREEN FOXTAIL. Europe.

Cenchrus
HEDGEHOG OR BURGRASS.
tribuloides L.

Zizania
INDIAN RICE. WATER OATS.
aquatica L.

Homalocenchrus
(*Leersia*)
oryzoides (L.) Poll.
Virginicus (Wild.) Britton

Phalaris.
REED CANARY GRASS.
arundinacea L. N. U. S.
Canariensis L. Europe.

Anthoxanthum
SWEET VERNAL GRASS.
odoratum L. Europe.

Aristida
TRIPLE-AWNED GRASS.
gracilis Ell.
purpurascens Poir.

Muhlenbergia
diffusa Schreb.
Mexicana (L.) Trin.
tenuiflora (Willd. B. S. P.)
(*M. Willdenovii* Trin.

Phleum
TIMOTHY.
pratense L. Europe

Alopecurus
pratensis L. Europe

Sporobolus
DROP-SEED GRASS.
neglectus Nash

Cinna
WOOD REED-GRASS.
arundinacea L.

Agrostis
BENT GRASS.
alba L. Europe
hyemalis (Walt.) B. S. P.
(*A. scabra* Willd.)
perennans (Walt.) Tuckerman

Avena
OAT.
sativa L. Europe
striata Michx.

Arrhenatherum
OAT GRASS
elatius (L.) Beauv. Europe
(*A. avenaceum* Beauv.)

Danthonia
WILD OAT GRASS.
spicata (L.) Beauv.

Spartina
CORD OR MARSH GRASS.
cynosuroides (L.) Willd.

Eleusine
Indica (L.) Gaertn. Asia

Tricuspis
(*Triodia* in part.)
sesleroides (Michx.) Torr.
(*Triodia cuprea* Jacq.)

Eragrostis
capillaris (L.) Nees
Frankii Steud.
hypnoides (L.) B. S. P.
(*E. reptans* Nees.)
major Host. Europe
pectinacea (Michx.) Steud.
pilosa (L.) Beauv. Europe
Purshii Schrad.

Eatonia
obtusata (Michx.) A. Gray
Pennsylvanica (DC.) A. Gray

Dactylis
ORCHARD-GRASS.
glomerata L. Europe

Poa
annua L. Asia
compressa L.
ENGLISH BLUE GRASS. Europe
pratensis L.
KENTUCKY BLUE GRASS.
sylvestris A. Gray

Panicularia
(*Glyceria*)
MANNA GRASS.
fluitans (L.) Kuntze N. U. S.
nervata (Willd.) Kuntze

Festuca
elatior L.
MEADOW FESCUE. Europe
nutans Willd.

Bromus
BROME GRASS.
ciliatus L.
racemosus L. Europe
secalinus L.
CHESS. CHEAT. Europe

Lolium
DARNEL.
perenne L. Europe

Agropyron
repens (L.) Beauv. Europe

Hordeum
SQUIRREL TAIL GRASS.
jubatum L. N. W. U. S.
nodosum L. W. U. S.
(*H. pratense* Huds.)
vulgare L. BARLEY. Europe

Elymus
WILD RYE.
Canadensis L.
striatus Willd.
Virginicus L.

Hystrix
BOTTLE-BRUSH GRASS.
(*Asprella*)
Hystrix (L.) Millsp.

CYPERACEAE

Dulichium
arundinaceum (L.) Britton
(*D. spathaceum* Pers.)

Cyperus
diandrus Torr.
esculentus L.
inflexus Muhl.
(*C. aristatus* Rottb.)
strigosus L.

Kyllinga
pumila Michx.

Scirpus
BULRUSH OR CLUBRUSH.
Americanus Pers.
(*S. pungens* Vahl.)
atrovirens Muhl.
lacustris L.
lineatus Michx.

Eleocharis
SPIKE-RUSH.
ovata (Roth) R. & S.

Fimbristylis
autumnalis (L.) R. & S.

Carex
SEDGE.
Albursina Sheldon
Careyana Torr. N. E. U. S.
cephalophora Muhl.
conjuncta Boott
crinita Lam.
cristatella Britton
Davisii Schwein. & Torr.
Frankii Kunth
(*C. stenolepis* Torr.)
granularis Muhl.
hystricina Muhl.

Jamesii Schwein.
laxiflora blanda (Dewey) Boott
laxiflora patulifolia (Dewey) Carey
lupulina Muhl.
muricata L. Europe
oligocarpa Schk.
Pennsylvanica Lam.
rosea Schk.
Shortiana Dewey
sparganioides Muhl.
triceps Michx.
varia Muhl.
vulpinoidea Michx.

ARACEAE

Acorus
SWEET FLAG.
Calamus L.

Spathyema
SKUNK CABBAGE.
(*Symplocarpus*)
foetida (L) Raf.

Arisaema
INDIAN TURNIP.
Dracontium (L.) Schott.
DRAGON-ROOT.
triphyllum (L.) Torr.

LEMNACEAE

Spirodela
polyrhiza (L.) Schleid

COMMELINACEAE

Commelina
nudiflora L.
Virginica L.

Tradescantia
SPIDERWORT.
pilosa J. G. C. Lehm.
Virginiana L.

JUNCACEAE

Juncus
RUSH. BOG-RUSH.
effusus L.
tenuis Willd.
Torreyi Coville. S. W. U. S.
(*J. nodosus* var. *megacephalus.*)

Juncoides
(*Luzula*)
WOOD-RUSH.
campestre (L.) Kuntze

LILIACEAE

Uvularia
BELLWORT
grandiflora J. E. Smith

Hemerocallis
DAY LILY.
fulva L. Europe

Allium
Canadense L.
WILD GARLIC.
cepa L.
CULTIVATED ONION.
cernuum Roth.
WILD ONION.
tricoccum Ait.
WILD LEEK. N. E. U. S.
sativum. C. Bauh. GARLIC. India

Lilium
Canadense L.
WILD YELLOW LILY.
superbum L.
TURK'S-CAP LILY.
tigrinum Andr. India

Erythronium
albidum Nutt.
WHITE DOG'S TOOTH VIOLET.
Americanum Ker.
YELLOW ADDER'S TONGUE.

Quamasia
(*Camassia*)
WILD HYACINTH.
esculenta (Ker) Coville
(*Camassia Fraseri* Torr.)

Ornithogalum
STAR OF BETHLEHEM.
umbellatum L. Europe

Muscari
GRAPE HYACINTH.
botryoides (L.) Mill. Europe

Yucca
YUCCA.
filamentosa L. W. U. S.

CONVALLARIACEAE

Asparagus
GARDEN ASPARAGUS.
officinalis L. Europe

Vagnera
(*Smilacina*)
FALSE SOLOMON'S SEAL.
racemosa (L.) Morong

Polygonatum
SOLOMON'S SEAL.
biflorum (Walt.) Ell.
commutatum (R. & S.) Dietr.
(*P. giganteum* Dietr.)

Convallaria
LILY-OF-THE-VALLEY.
majalis L.

Trillium
WAKE ROBIN.
cernuum L.
erectum L.
recurvatum Beck
sessile L.

SMILACEAE

Smilax
GREENBRIER.
ecirrhata (Engelm.) Wats.
glauca Walt.
herbacea L.
CARRION-FLOWER.
hispida Muhl.

AMARYLLIDACEAE

Hypoxis
STAR-GRASS.
hirsuta (L.) Coville
(*H. erecta* L.)

DIOSCOREACEAE

Dioscorea
YAM.
villosa L.

IRIDACEAE

Iris
FLOWER DE LUCE.
versicolor L.
BLUE-FLAG.

Sisyrinchium
BLUE-EYED GRASS.
graminoides Bicknell
(*S. anceps* of Gray's Manual, 6th Edition, not Cav.)

ORCHIDACEAE

Orchis
spectabilis L.
SHOWY ORCHIS.

Habenaria
peramoena A. Gray

Gyrostachys
(*Spiranthes*)
LADIES' TRESSES.
cernua (L.) Kuntze
gracilis Willd.

Leptorchis
(*Liparis*)
liliifolia (L.) Kuntze

Pogonia
trianthophora (Sw.) B. S. P.

Corallorhiza
CORAL-ROOT.
odontorhiza (Willd.) Nutt.
Wisteriana Conrad

Aplectrum
PUTTY-ROOT.
spicatum (Walt.) B. S. P.
(*A. hiemale* Nutt.)

SAURURACEAE

Saururus
LIZARD'S TAIL.
cernuus L.

JUGLANDACEAE

Juglans
cinerea L.
BUTTERNUT.
nigra L.
BLACK WALNUT.

Hicoria
(*Carya*)
HICKORY.
alba (L.) Britton
(*C. tomentosa* Nutt.)
glabra (Mill.) Britton
(*C. porcina* Nutt.)
laciniosa (Michx. f.) Sargent
(*C. sulcata* Nutt.)
minima (Marsh.) Britton
(*C. amara* Nutt.)
ovata (Mill.) Britton
SHELL-BARK
(*C. alba* Nutt.)

SALICACEAE

Populus
POPLAR. ASPEN.
alba L.
WHITE POPLAR. Europe
balsamifera candicans (Ait.) A. Gray
deltoides Marsh
(*P. monilifera* Ait.)
NECKLACE POPLAR.
dilatata Ait. Europe
grandidentata Michx.
tremuloides Michx. N. U. S.

Salix
WILLOW.
alba vitellina (L.) Koch Europe
Babylonica L.
WEEPING WILLOW. Asia
cordata Muhl.
discolor Muhl.
interior Rowlee
(*S. longifolia* Muhl.)
nigra Marsh.
BLACK WILLOW.
purpurea L. Europe
sericea Marsh.
SILKY WILLOW.

BETULACEAE

Carpinus
IRON-WOOD.
Caroliniana Walt.

Ostrya
AMERICAN HOP-HORNBEAM.
Virginiana (Mill.) Willd.

Corylus
HAZEL-NUT.
Americana Walt.

Betula
BIRCH.
populifolia Marsh.
WHITE BIRCH.

FAGACEAE

Fagus
BEECH.
Americana Sweet
(*F. ferruginea* Ait)

Castanea
pumila (L.) Mill.
CHINQUAPIN.

Quercus
acuminata (Michx.) Houba
(*Muhlenbergii* Engelm.)
alba L.
WHITE OAK.
coccinea Wang.
SCARLET OAK.
imbricaria Michx.
LAUREL OAK.
Leana Nutt.
macrocarpa Michx.
MOSSY-CUP OAK.
palustris Du Roi
platanoides (Lam.) Sudw.
(*bicolor* Willd.)
rubra L.
RED OAK.
velutina Lam.
(*tinctoria* Bartr.)

ULMACEAE

Ulmus
ELM.
Americana L.
pubesceus Walt.
SLIPPERY OR RED ELM.
(*U. fulva* Michx.)
racemosa Thomas

Celtis
HACKBERRY.
occidentalis L.

MORACEAE

Morus
MULBERRY.
rubra L.

Toxylon
(*Maclura*)
OSAGE ORANGE.
pomiferum Raf. S. W. U. S.
(*M. aurantiaca* Nutt.)

Broussonetia
papyrifera (L.) Vent. Japan

Humulus
HOP.
Lupulus L.

Cannabis
HEMP.
sativa L. Europe

URTICACEAE

Urtica
NETTLE.
dioica Pursh Europe
gracilis Ait.

Urticastrum
(*Laportea*)
WOOD-NETTLE.
divaricatum (L.) Kuntze
(*L. Canadensis* Gaud.)

Adicea
(*Pilea*)
RICHWEED. CLEARWEED.
pumila (L.) Raf.

Boehmeria
FALSE NETTLE.
cylindrica (L.) Willd. E. U. S.

Parietaria
PELLITORY.
Pennsylvanica Muhl.

LORANTHACEAE

Phoradendron
FALSE MISTLETOE.
flavescens (Pursh) Nutt.

SANTALACEAE

Comandra
umbellata (L.) Nutt.

ARISTOLOCHIACEAE

Asarum
WILD GINGER.
Canadense L.
reflexum Bicknell

Aristolochia
BIRTHWORT.
Serpentaria L.

POLYGONACEAE

Rumex

acetosella L.
FIELD OR SHEEP SORREL. Europe
altissimus Wood.
crispus L.
CURLED DOCK. Europe
obtusifolius L.
BITTER DOCK. Europe

Polygonum

KNOTWEED.
aviculare L.
Convolvulus L.
BLACK BINDWEED. Europe
erectum L.
Hydropiper L.
COMMON SMARTWEED. Europe
hydropiperoides Michx.
incarnatum Ell.
orientale L. India
Pennsylvanicum L.
Persicaria L.
LADY'S THUMB. Europe.
punctatum Ell.
(*P. acre* H B. K.
sagittatum L.
scandens L.
Virginianum L.

Fagopyrum

BUCKWHEAT.
Fagopyrum (L.) Karst.
(*F. esculentum* Moench.) Europe

CHENOPODIACEAE

Chenopodium

album L.
LAMB'S-QUARTERS. Europe
ambrosioides L.
MEXICAN TEA. Trop. Amer.
Boscianum Moq.
Botrys L. Europe & Asia
glaucum L. Europe
murale L. Europe
urbicum L. Europe

Atriplex

ORACHE.
hastata L. W. U. S.
patula L.

AMARANTHACEAE

Amaranthus

AMARANTH.
graecizans L.
TUMBLE WEED. Asia
hybridus L. Trop. Amer.
(*A. chlorostachys* Willd.)
hybridus paniculatus (L.) U. & B Trop. Amer.
retroflexus L. Trop. Amer.
spinosus L.
THORNY AMARANTH. S. U. S.

Iresine

paniculata (L.) Kuntze
(*I. celosioides* L.)

Acnida

tamariscina tuberculata Moq. S. W. U. S.

PHYTOLACCACEAE

Phytolacca

POKEWEED.
decandra L.

NYCTAGINACEAE

Allionia

(*Oxybaphus*)
FOUR O'CLOCK.
nyctaginea Michx. W. U. S.

AIZOACEAE

Mollugo

INDIAN CHICKWEED.
verticillata L. S. W. U. S.

PORTULACACEAE

Claytonia

SPRING BEAUTY.
Caroliniana Michx.
Virginica L.

Portulaca
GARDEN PORTULACA.
grandiflora Hook.
oleracea L.
PURSLANE. S. W. U. S.

CARYOPHYLLACEAE

Agrostemma
CORN COCKLE.
Githago L. Europe, N. Asia
(*Lychnis Githago* Lam.)

Silene
CATCHFLY. CAMPION.
alba Muhl.
(*S. nivea* Otth)
antirrhina L.
Caroliniana Walt.
(*S. Pennsylvanica* Michx.
stellata (L.) Ait. f.
STARRY CAMPION.
Virginica L.
FIRE PINK. CATCHFLY.
vulgaris (Moench) Garcke. Europe

Lychnis
COCKLE.
dioica L. Europe
(*L. diurna* Sibth.)

Saponaria
BOUNCING BET.
officinalis L. Europe

Alsine
(*Stellaria*)
CHICKWEED.
media L. Europe
pubera (Michx.) Britton

Cerastium
CHICKWEED.
arvense L.
longipedunculatum Muhl.
(*C. nutans* Raf.)
viscosum L. Europe
vulgatum L. Europe

Holosteum
umbellatum L. Europe

Arenaria
SANDWORT.
serpyllifolia L. Europe

Anychia
FORKED CHICKWEED.
Canadensis (L.) B. S P.
(*A. capillacea* DC.)
dichotoma Michx.

NYMPHAEACEAE

Nymphaea
(*Nuphar*)
YELLOW POND LILY.
advena Soland

Castalia
(*Nymphaea*)
WATER LILY.
odorata (Dryand) Wood.

CERATOPHYLLACEAE

Ceratophyllum
HORNWORT.
demersum L.

MAGNOLIACEAE

Magnolia
CUCUMBER TREE.
acuminata L.
Fraseri Walt.

Liriodendron
TULIP TREE.
Tulipifera L.

ANNONACEAE

Asimina
PAPAW.
triloba (L.) Dunal

RANUNCULACEAE

Hydrastis
ORANGE ROOT.
Canadensis L.

Caltha
MARSH MARIGOLD.
palustris L.

Isopyrum
biternatum (Raf.) T. & G.

Actaea
WHITE BANEBERRY.
alba (L.) Mill.

Cimicifuga
BLACK SNAKEROOT. BLACK COHOSH.
racemosa (L.) Nutt.

Aquilegia
COLUMBINE.
Canadensis L.
vulgaris L. Europe

Delphinium
LARKSPUR
Ajacis L. Europe
Carolinianum Walt.
(*D. azureum* Michx.)
tricorne Michx.
DWARF LARKSPUR. S. W. U. S.

Anemone
WIND-FLOWER.
Canadensis L.
(*A. Pennsylvanaica* L.)
Virginiana L.

Hepatica
LIVER-LEAF.
acuta (Pursh) Britton
(*H. acutiloba* DC.)

Syndesmon
(*Anemonella*)
thalictroides (L.) Hoffm.

Clematis
VIRGIN'S-BOWER.
Viorna L.
LEATHER-FLOWER.
Virginiana L.

Ranunculus
CROWFOOT. BUTTERCUP.
abortivus L.
SMALL-FLOWERED CROWFOOT.
micranthus Nutt.
recurvatus Poir.
repens L. Europe
sceleratus L.
CURSED CROWFOOT. N. E. U. S.
septentrionalis Poir.

Thalictrum
MEADOW-RUE.
dioicum L.
polygamum Muhl. E. U. S.
purpurascens L.
PURPLISH MEADOW-RUE. N. E. U. S.

Batrachium
(*Ranunculus* in part.)
trichophyllum (Chaix) Bossch
(*Ranunculus circinatus* Sibth)

BERBERIDACEAE

Podophyllum
MAY APPLE.
peltatum L.

Jeffersonia
TWIN-LEAF.
diphylla (L.) Pers.

Caulophyllum
BLUE COHOSH.
thalictroides (L.) Michx.

Berberis
BARBERRY.
vulgaris L. Europe

MENISPERMACEAE

Menispermum
MOONSEED
Canadense L.

LAURACEAE

Sassafras

Sassafras (L.) Karst.
(*S. officinale* Nees & Eberm.)

Benzoin

(*Lindera*)
FEVER-BUSH. WILD-ALLSPICE.
Benzoin (L.) Coult.

PAPAVERACEAE

Sanguinaria

BLOOD-ROOT.
Canadensis L.

Stylophorum

CELANDINE POPPY.
diphyllum (Michx.) Nutt.
W. U. S.

Chelidonium

CELANDINE.
majus L. Europe

Argemone

MEXICAN POPPY.
Mexicana L. Trop. Amer.

Papaver

COMMON POPPY.
Argemone L.
somniferum L. Europe

FUMARIACEAE

Bicuculla

(*Dicentra*)
Canadensis (Goldie) Millsp.
SQUIRREL CORN.
Cucullaria (L.) Millsp.
DUTCHMAN'S BREECHES.

Capnoides

(*Corydalis*)
CORYDALIS
flavulum (Raf.) Kuntze

CRUCIFERAE

Lepidium

PEPPERGRASS
campestre (L.) R. Br. Europe
ENGLISH PEPPERGRASS.
ruderale L. Europe
Virginicum L.

Sisymbrium

HEDGE MUSTARD.
officinale (L.) Scop. Europe

Brassica

campestris L. Europe
TURNIP.
nigra (L.) Koch. Europe
BLACK MUSTARD.

Raphanus

GARDEN RADISH.
sativus L. Europe

Barbarea

WINTER CRESS.
Barbarea (L.) MacM. Europe
(*B. vulgaris* R. Br.

Roripa

(*Nasturtium*)
Armoracia (L.) A. S. Hitchc.
Europe
HORSE RADISH.
Nasturtium (L.) Rusby. Europe
(*N officinale* R. Br.)
WATER CRESS.
palustris (L.) Bess.
MARSH CRESS.

Cardamine

hirsuta L.
BITTER CRESS.
purpurea (Torr.) Britton

Dentaria

TOOTHWORT.
diphylla Michx.
PEPPER ROOT.
laciniata Muhl.
CUT-LEAVED TOOTHWORT.

Bursa
SHEPHERD'S PURSE.
Bursa-Pastoris (L.) Brit.
(*Capsella*) Europe

Draba
WHITLOW GRASS.
verna L. Europe

Sophia
pinnata (Walt.) Howell.
(*Sisymbrium canescens* Nutt.

Arabis
ROCK CRESS.
Canadensis L.
SICKLE-POD.
glabra (L.) Bernh.
TOWER MUSTARD.
(*A. perfoliata* Lam.)
hirsuta (L.) Scop.
laevigata (Muhl.) Poir.

Iodanthus
dentatus (T. & G.) Greene
(*Arabis dentata* T. & G.)
pinnatifidus (Michx.) Steud
(*Thelypodium pinnatifidum*)

Cheiranthus
(*Erysimum*)
WORM-SEED MUSTARD.
cheiranthoides (L.) Heller

Konig
maritima (L.) R. Br. Europe
(*Alyssum maritimum* L.)

Hesperis
DAME'S VIOLET.
matronalis L. Europe

CAPPARIDACEAE

Polanisia
CLAMMY WEED.
graveolens Raf. W. U. S.

RESEDACEAE

Reseda
MIGNONETTE.
odorata L. Europe.

CRASSULACEAE

Sedum
STONE-CROP. ORPINE.
telephioides Michx. S. E. U. S.
ternatum Michx. South E.U.S.

Penthorum
DITCH STONE-CROP.
sedoides L.

SAXIFRAGACEAE

Saxifraga
SAXIFRAGE.
Virginiensis Michx. N. E. U. S.

Heuchera
ALUM ROOT.
Americana L.

Mitella
MITRE-WORT. BISHOP'S-CAP.
diphylla L.

HYDRANGEACEAE

Philadelphus
MOCK-ORANGE or SYRINGA.
coronarius L. Europe
inodorus L. Europe.

Hydrangea
arborescens L.
WILD HYDRANGEA.

GROSSULARIACEAE

Ribes
aureum Pursh
MISSOURI CURRANT. W. U. S.
Cynosbati L.
WILD GOOSEBERRY. N. E. U. S.
rubrum L. Europe

HAMAMELIDACEAE

Liquidambar
SWEET-GUM TREE.
Styraciflua L.

Hamamelis
WITCH-HAZEL.
Virginiana L.

PLATANACEAE

Platanus
SYCAMORE. BUTTON-WOOD.
occidentalis L.

ROSACEAE

Opulaster
(*Physocarpus*)
opulifolius (L.) Kuntze

Spiraea
MEADOW-SWEET.
salicifolia L.

Porteranthus
(*Gillenia*)
INDIAN PHYSIC.
stipulatus (Muhl.) Britton
S. W. U. S.

Rubus
Canadensis L.
DEWBERRY.
occidentalis L.
BLACK RASPBERRY.
villosus Ait.
BLACKBERRY.

Fragaria
STRAWBERRY.
Virginiana Duchesne
(*F. Virginiana* var. *Illinoensis*)

Potentilla
CINQUE-FOIL. FIVE-FINGER.
Canadensis L.
Monspeliensis L.
(*P. Norwegica*)
recta L. Europe Asia

Drymocallis
(*Potentilla* in part)
arguta (Pursh) Rydb.

Geum
AVENS.
Canadense Jacq.
(*G. album* Gmel.)
vernum (Raf.) T. & G.
Virginianum L.

Agrimonia
AGRIMONY.
mollis (T. & G.) Britton

Rosa
ROSE.
blanda Ait.
humilis Marsh.
rubiginosa L.
SWEET BRIAR. Europe
setigera Michx.

POMACEAE

Malus
(*Pyrus in part*)
APPLE.
coronaria (L.) Mill.
CRAB-APPLE.
Malus (L.) Britton Europe

Amelanchier
JUNE-BERRY.
Canadensis (L.) Medic.

Crataegus
HAWTHORN. WHITE THORN.
coccinea L.
Crus-galli L.
mollis (T. & G.) Scheele.
Oxyacantha L. Europe
punctata Jacq.

DRUPACEAE

Prunus
PLUM, CHERRY.
Americana Marsh.
mahaleb L.
serotina Ehrh.

Amygdalus
PEACH.
Persica L. Asia

CAESALPINACEAE

Cercis
RED-BUD. JUDAS-TREE.
Canadensis L.

Cassia
SENNA.
Marylandica L.

Chamaecrista
(*Cassia* in part)
PARTRIDGE PEA.
fascicularis (Michx.) Greene
(*Cassia chamaecrista* L.)

Gleditsia
triacanthos L.
HONEY LOCUST.

Gymnocladus
KENTUCKY COFFEE-TREE.
dioicus (L.) Koch.
(*G. Canadensis* Lam.)

PAPILIONACEAE

Cladrastis
YELLOW-WOOD.
lutea (Michx. f.) Koch
(*C. tinctoria* Raf.)

Baptisia
INDIGO.
australis (L.) R. Br.
FALSE INDIGO. S. W. U. S.
tinctoria (L.) R. Br.
WILD INDIGO.

Medicago
MEDICK.
lupulina L.
BLACK MEDICK. Europe
Sativa L.
LUCERNE. ALFALFA. Europe

Melilotus
SWEET CLOVER, MELILOT.
alba Desv. Europe
officinalis (L.) Lam. Europe

Trifolium
CLOVER.
arvense L.
RABBIT-FOOT. Europe
incarnatum L. Europe
pratense L.
RED CLOVER. Europe
repens L.
WHITE CLOVER. Europe
stoloniferum Muhl.
BUFFALO CLOVER. W. U. S.

Chrysaspis
(*Trifolium* in part)
agraria (L.) Greene Europe

Psoralea
Onobrychis Nutt.

Amorpha
HOARY PEA.
fruticosa L.

Cracca
(*Tephrosia*)
Virginiana L.

Kraunhia
(*Wisteria*)
WISTERIA.
frutescens (L.) Greene

Robinia
LOCUST-TREE.
Pseudacacia L. S. U. S.

Astragalus
Carolinianus L.
(*A. Canadensis* L.)

Phaca
(*Astragalus* in part)
neglecta T. & G.

Meibomia
(*Desmodium*)
TICK-TREFOIL.
bracteosa (Michx.) Kuntze
(*D. cuspidatum* Hook.)
canescens (L.) Kuntze
Dillenii (Darl.) Kuntze
grandiflora (Walt.) Kuntze
(*D. acuminatum* DC.)
Michauxii Vail
(*D. rotundifolium* DC.)
nudiflora (L.) Kuntze
paniculata (L.) Kuntze
pauciflora (Nutt) Kuntze

Lespedeza
BUSH-CLOVER.
procumbens Michx.

Vicia
VETCH. TARE.
sativa L. Europe

Falcata
(*Amphicarpaea*)
HOG PEA-NUT.
comosa (L.) Kuntze
(*A. monoica* Nutt.)

Strophostyles
(*Phaseolus* in part)
KIDNEY BEAN.
helvola (L.) Britton
(*S. angulosa* Ell.)

GERANIACEAE

Geranium
CRANESBILL.
Carolinianum L.
maculatum L.
WILD CRANESBILL.

OXALIDACEAE

Oxalis
WOOD-SORREL.
grandis Small
stricta L.
YELLOW WOOD-SORREL.
violacea L
VIOLET WOOD-SORREL.

LINACEAE

Linum
FLAX.
usitatissimum L. Europe.

RUTACEAE

Xanthoxylum
PRICKLY ASH.
Americanum Mill.

Ptelea
HOP-TREE. SHRUBBY TREFOIL.
trifoliata L.

SIMARUBACEAE

Ailanthus
TREE OF HEAVEN.
glandulosus Desf. China

POLYGALACEAE

Polygala
MILKWORT.
Senega L.
SENECA SNAKEROOT.
viridescens L.
(*P. sanguinea* L.

EUPHORBIACEAE

Phyllanthus
Carolinensis Walt.

Croton
capitatus Michx. S. W. U. S.

Acalypha
THREE-SEEDED MERCURY.
Virginica L.

Ricinus
CASTOR OIL PLANT.
communis L. Africa

Euphorbia
SPURGE.
commutata Engelm.
corollata L.
Cyparissias L. Europe.
dentata Michx. S. W. U. S.
maculata L.
marginata Pursh. S. W. U. S.
obtusata Pursh. S. W. U. S.
Preslii Guss.
(*E. nutans* of authors, not Lag.)

CALLITRICHACEAE

Callitriche
WATER STAR-WORT.
Austini Engelm.

LIMNANTHACEAE

Floerkea
proserpinacoides Willd.

ANACARDIACEAE

Cotinus
SMOKE TREE.
cotinoides (Nutt.) Britton
(*Rhus cotinoides* Nutt.)

Rhus
SUMACH.
copallina L.
DWARF SUMACH.
glabra L.
SMOOTH SUMACH.
hirta (L.) Sudw.
STAGHORN SUMACH.
(*R. typhina* L.)
radicans L.
POISON IVY. POISON OAK.

AQUIFOLIACEAE

Ilex
opaca Ait.
AMERICAN HOLLY.
verticillata (L.) A. Gray
BLACK ALDER.

CELASTRACEAE

Euonymus
SPINDLE-TREE.
atropurpureus Jacq.
WAAHOO.
obovatus Nutt.

Celastrus
SHRUBBY BITTER-SWEET.
scandens L.

STAPHYLEACEAE

Staphylea
trifolia L.

ACERACEAE

Acer
MAPLE.
Negundo L.
BOX-ELDER.
(*Negundo aceroides* Moench)
nigrum Michx.
platanoides L.
rubrum L.
RED OR SWAMP MAPLE.
saccharinum L.
SILVER MAPLE.
(*A. dasycarpum* Ehrh.)
saccharum Marsh.
SUGAR OR ROCK MAPLE.
(*A. saccharinum* Wang.)

HIPPOCASTANACEAE

Aesculus

BUCKEYE.
glabra Willd.
FETID OR OHIO BUCKEYE.
Hippocastanum L.
HORSE CHESTNUT. Asia
octandra Marsh.
SWEET BUCKEYE.
(*A. flava* Ait.) S. W. U. S.
hybrida (DC,) Sargent
(*A. flava* var. *purpurascens*)

Koelreuteria

paniculata Laxm. Japan

SAPINDACEAE

Cardiospermum

HEART-SEED. BALLOON PEA.
Halicacabum L. Trop. Amer.

BALSAMINACEAE

Impatiens

JEWEL WEED BALSAM.
aurea Muhl.
(*I. pallida* Nutt.)
biflora Walt.
(*I. fulva* Nutt.)

RHAMNACEAE

Rhamnus

BUCKTHORN.
lanceolata Pursh. S. W. U. S.

Ceanothus

NEW JERSEY TEA.
Americanus L.

VITACEAE

Vitis

aestivalis Michx.
SUMMER GRAPE.
cordifolia Michx.
FROST OR CHICKEN GRAPE.

Parthenocissus

(*Ampelopsis* in part)
VIRGINIA CREEPER.
quinquefolia (L.) Planch.

Ampelopsis

arborea (L.) Rusby
(*Cissus stans* Pers.)

TILIACEAE

Tilia

LINDEN. BASSWOOD.
Americana L.
heterophylla Vent.
WHITE BASSWOOD.

MALVACEAE

Abutilon

INDIAN MALLOW.
Abutilon (L.) Rusby. Asia
(*A. Avicennae* Gaertn.)

Malva

MALLOW.
rotundifolia L. Europe

Sida

spinosa L. Tropical America

Hibiscus

ROSE MALLOW.
militaris Cav. HALBERD-LEAVED ROSE-MALLOW
Syriacus L.
Trionum L.
BLADDER KETMIA. Europe

HYPERICACEAE

Ascyrum

ST. PETER'S WORT.
hypericoides L.
(*A. Crux-Andreae* L.)

Hypericum

ST. JOHN'S WORT.
Canadense L.
Drummondii (Grev. & Hook.)
maculatum Walt.
mutilum L.
prolificum L.

Sarothra
gentianoides L.
(*Hypericum nudicaule* Walt.

VIOLACEAE

Cubelium
(*Solea*)
GREEN VIOLET.
concolor (Forst.) Raf.

Viola
VIOLET.
Canadensis L.
odorata L.
obliqua Hill.
palmata L.
COMMON BLUE VIOLET.
pubescens Ait.
DOWNY YELLOW VIOLET.
Rafinesquii Greene
(*tricolor* var. *arvensis* DC.)
striata Ait.
PALE VIOLET.
tricolor L. PANSY. Europe

PASSIFLORACEAE

Passiflora
PASSION-FLOWER.
lutea L.

LYTHRACEAE

Rotala
ramosior (L.) Koehne

Lythrum
WING-ANGLED LOOSESTRIFE.
alatum Pursh

Parsonsia
(*Cuphea*)
petiolata (L.) Rusby
(*Cuphea viscosissima* Jacq.
CLAMMY CUPHEA.

MELASTOMACEAE

Rhexia
MEADOW BEAUTY.
Virginica L.

ONAGRACEAE

Ludwigia
FALSE LOOSE-STRIFE.
alternifolia L.
SEED BOX.

Isnardia
(*Ludwigia* in part)
WATER PURSLANE.
palustris L.

Epilobium
WILLOW-HERB.
coloratum Muhl.

Onagra
(*Oenothera* in part)
EVENING PRIMROSE.
biennis (L.) Scop.
grandiflora (Ait.) Lindl.

Gaura
biennis L.

Circaea
ENCHANTER'S NIGHT SHADE.
Lutetiana L.

ARALIACEAE

Panax
(*Aralia* in part)
GINSENG.
quinquefolium L.

Aralia
SPIKENARD.
racemosa L.

UMBELLIFERAE

Sanicula
BLACK SNAKE-ROOT.
Canadensis L.
Marylandica L.

Chaerophyllum
CHERVIL.
procumbens (L.) Crantz
Shortii T. & G.

Washingtonia
(*Osmorrhiza*)
SWEET CICELY.
Claytoni (Michx.) Britton
(*O. brevistylis* DC.)
longistylis (Torr.) Britton

Caucalis
HEDGE PARSLEY.
Anthriscus (L.) Huds. Europe

Erigenia
HARBINGER-OF-SPRING.
bulbosa (Michx.) Nutt.

Bupleurum
THOROUGHWORT.
rotundifolium L. Europe

Zizia
MEADOW PARSNIP.
aurea (L.) Koch

Cicuta
WATER-HEMLOCK.
bulbifera L. N. E. U. S.
maculata L.
SPOTTED COWBANE.

Deringa
(*Cryptotaenia*)
HONEWORT.
Canadensis (L.) Kuntze

Carum
CARAWAY.
Carui L. Europe

Taenidia
YELLOW PIMPERNEL.
integerrima (L.) Drude
(*Pimpinella integerrima* L.)

Thaspium
MEADOW-PARSNIP.
barbinode (Michx.) Nutt.
trifoliatum (L.) Britton

Pastinaca
PARSNIP.
sativa L. Europe

Daucus
CARROT.
Carota L. Europe

CORNACEAE

Nyssa
SOUR-GUM.
sylvatica Marsh.
(*N. multiflora* Wang.)

Cornus
DOGWOOD.
Amonum Mill.
(*C. sericea* L.)
asperifolia Michx.
candidissima Marsh.
(*C. paniculata* L'Her.)
florida L.

MONOTROPACEAE

Monotropa
INDIAN PIPE.
uniflora L.

PRIMULACEAE

Samolus
BROOK-WEED.
floribundus H. B. K.
(*S. Valerandi* var. *Americana*)

Lysimachia
LOOSESTRIFE.
nummularia L.
MONEYWORT. Europe
quadrifolia L.
terrestris (L.) B. S. P.
(*L. stricta* Ait.)

Steironema
ciliatum (L.) Raf.
lanceolatum (Walt.) A. Gray

Anagallis
PIMPERNEL.
arvensis L. Europe

Dodecatheon
AMERICAN COWSLIP.
Meadia L.

EBENACEAE

Diospyros
PERSIMMON.
Virginiana L.

OLEACEAE

Fraxinus
Americana L.
WHITE ASH.
nigra Marsh.
(*F. sambucifolia* Lam.)
BLACK ASH.
quadrangulata Michx.
BLUE ASH.

Syringa
LILAC.
vulgaris L. Europe

Chionanthus
FRINGE-TREE.
Virginica L.

Ligustrum
PRIVET.
vulgare L.

GENTIANACEAE

Sabbatia
angularis (L.) Pursh

Obolaria
PENNYWORT.
Virginica L.

Gentiana
GENTIAN.
Andrewsii Griseb

Frasera
AMERICAN COLUMBO.
Carolinensis Walt.

APOCYNACEAE

Vinca
minor L. Europe

Apocynum
DOGBANE. INDIAN HEMP.
androsaemifolium L.
cannabinum L.

ASCLEPIADACEAE

Asclepias
MILKWEED.
exaltata (L.) Muhl.
(*A. phytolaccoides* Pursh)
incarnata L.
quadrifolia Jacq.
Syriaca L.
(*A. Cornuti* Dec.)
tuberosa L.
BUTTERFLY-WEED.
PLEURISY-ROOT.

Gonolobus
(*Ampelanus; Enslenia*)
laevis Michx.
(*Enslenia albida* Nutt.)

Vincetoxicum
(*Gonolobus* of authors, not Michx.
gonocarpos Walt.
(*G. macrophyllus* Willd.)
obliquum (Jacq.) Britton
S. E. U. S.

CONVOLVULACEAE

Quamoclit
(*Ipomoea* in part)
coccinea (L.) Moench
Trop. Amer.

Ipomoea
MORNING GLORY.
hederacea (L.) Jacq.
Trop. Amer.
lacunosa L. S. W. U. S.
pandurata (L.) Meyer
WILD POTATO-VINE.
purpurea (L.) Roth
Trop. Amer.

Convolvulus
BINDWEED
arvensis L. Europe
sepium L.
HEDGE BINDWEED.
spithamaeus L.

CUSCUTACEAE

Cuscuta
DODDER.
arvensis Beyrich
Gronovii Willd.

POLEMONIACEAE

Phlox
divaricata L.
maculata L.
paniculata L.

Polemonium
GREEK VALERAIN.
reptans L.

HYDROPHYLLACEAE

Hydrophyllum
WATERLEAF.
appendiculatum Michx.
Canadense L.
macrophyllum Nutt.
Virginicum L.

Phacelia
bipinnatifida Michx. S.W. U. S.
Purshii Buckley

BORAGINACEAE

Heliotropium
HELIOTROPE.
Indicum L. India

Cynoglossum
HOUND'S-TONGUE.
officinale L. Europe
Virginicum L.
WILD COMFREY.

Lappula
(*Echinospermum*)
STICKSEED
Lappula (L.) Karst. Europe
Virginiana (L.) Greene

Mertensia
LUNGWORT.
Virginica (L.) DC.

Lithospermum
PUCCOON.
arvense L. Europe
canescens (Michx.) Lehm.
latifolium Michx.

Echium
BLUE-WEED.
vulgare L.

VERBENACEAE

Verbena
VERVAIN.
augustifolia Michx.
bracteosa Michx. W. U. S.
hastata L.
BLUE VERVAIN.
stricta Vent.
HOARY VERVAIN.
urticaefolia L.
WHITE VERVAIN.

Phyla
(*Lippia* in part)
FOG-FRUIT.
lanceolata (Michx.) Greene

LABIATAE

Teucrium
GERMANDER.
Canadense L.

Isanthus
FALSE PENNYROYAL.
brachiatus (L.) B. S. P.
(*I. coeruleus* Michx.)

Scutellaria
SKULLCAP.
cordifolia Muhl.
incana Muhl.
(*S. canescens.*)
lateriflora L.
nervosa Pursh
parvula Michx.

Marrubium
HOREHOUND.
vulgare L. Europe

Agastache
(*Lophanthus*)
GIANT HYSSOP.
nepetoides (L.) Kuntze
scrophulariaefolia (Willd.) Kuntze.

Nepeta
CAT-MINT.
Cataria L.
CATNIP. Europe

Glecoma
GROUND IVY.
hederacea L. Europe
(*Nepeta Glechoma* Benth.)

Prunella
SELF-HEAL.
vulgaris L. Europe

Synandra
hispidula (Michx.) Britton
(*S. grandiflora* Nutt.)

Lamium
DEAD-NETTLE.
amplexicaule L. Europe

Leonurus
MOTHERWORT.
Cardiaca L. Europe

Salvia
SAGE.
lyrata L.
officinalis L.
GARDEN SAGE. Europe

Stachys
HEDGE-NETTLE.
aspera Michx.
cordata Riddell S. E. U. S.
tenuifolia Willd.
(*S. aspera* var. *glabra* A. Gray)

Monarda
HORSE-MINT.
fistulosa L.

Blephilia
hirsuta (Pursh) Torr.

Hedeoma
MOCK PENNYROYAL.
pulegioides (L.) Pers.

Melissa
BALM.
officinalis L. Europe

Clinopodium
(*Calamintha*)
CALAMINT.
vulgare L.
(*C. Clinopodium* Benth.)

Koellia
(*Pycnanthemum*)
BASIL.
flexuosa (Walt.) MacM.
pilosa (Nutt.) Britton
Virginiana (L.) MacM.
(*P. lanceolatum* Pursh)

Lycopus
WATER-HOREHOUND.
Americanus Muhl.
(*L. sinuatus* Ell.)
Virginicus L.

Mentha
MINT.
Canadensis L. N. U. S.
piperita L.
PEPPERMINT. Europe
spicata L.
(*M. viridis* L.) Europe

Collinsonia
HORSE-BALM.
Canadensis L.

SOLANACEAE

Physalodes
(*Nicandra*)
APPLE OF PERU.
Physalodes (L.) Brit. South. Am.

Lycium
MATRIMONY VINE.
vulgare (Ait. f.) Dunal Europe

Physalis
GROUND CHERRY.
heterophylla Nees
pubescens L.
Virginiana Mill.

Solanum
NIGHTSHADE.
Carolinense L.
Dulcamara L. Europe
nigrum L.
rostratum Dunal W. U. S.
tuberosum L.

Lycopersicon
TOMATO.
Lycopersicon (L.) Karst.
(*L. esculentum* Mill.)
Trop. Amer.

Datura
JAMESTOWN WEED, JIMSON.
Stramonium L. Asia
Tatula L. Trop. Amer.

Nicotiana
TOBACCO.
Tabacum L. South Amer.

SCROPHULARIACEAE

Verbascum
MULLEIN.
Blattaria L. Europe
Thapsus L. Europe

Linaria
TOAD-FLAX.
Linaria (L.) Karst. Europe
(*L. vulgaris* Mill.)

Antirrhinum
Majus L. Europe

Collinsia
verna Nutt.

Scrophularia
Marylandica L.

Chelone
TURTLE-HEAD. SNAKE-HEAD.
glabra L.

Pentstemon
BEARD-TONGUE.
hirsutus (L.) Willd.
(*P. pubescens* Soland.)
Pentstemon (L.) Britton
(*P. laevigatus* Soland.)

Paulownia
tomentosa (Thurb.) Baill. Japan
(*P. imperialis* Sieb. & Zucc.)

Mimulus
MONKEY-FLOWER.
alatus Soland.
ringens L.

Gratiola
HEDGE HYSSOP.
Virginiana L.

Ilysanthes
FALSE PIMPERNEL.
dubia (L.) Barnhart
(*I. gratioloides* Benth.)

Veronica
SPEEDWELL.
peregrina L.
serpyllifolia L.

Leptandra
Virginica (L.) Nutt.
(*Veronica Virginica* (L.)

Digitalis
purpurea L. Europe

Afzelia
(*Seymeria*)
MULLEN FOXGLOVE.
macrophylla (Nutt.) Kuntze
W. U. S.

Gerardia
purpurea L.
tenuifolia Vahl.

Melampyrum
COW-WHEAT.
lineare Lam.
(*M. Americanum* Michx.)

Pedicularis
Canadensis L.
multifida (Mx.) Benth.

OROBANCHACEAE

Conopholis
SQUAW-ROOT.
Americana (L. f.) Wallr.

Orobanche
(*Aphyllon* in part)
NAKED BROOM-RAPE.
Ludoviciana Nutt.

Thalesia
(*Aphyllon*)
CANCER-ROOT.
uniflora (L.) Britton

Leptamnium
(*Epiphegus*)
BEECH-DROPS.
Virginianum (L.) Raf.

BIGNONIACEAE

Catalpa
Catalpa (L.) Karst. S. W. U. S.
(*C. bignonioides* Walt.)
speciosa Warder. S. W. U. S.

Campsis
TRUMPET-FLOWER.
radicans (L.) Seem.
(*Tecoma radicans* DC.)

MARTYNIACEAE

Martynia
UNICORN-PLANT.
Louisiana Mill. S. U. S.
(*M. proboscidea* Glox.)

ACANTHACEAE

Ruellia
strepens L. S. W. U. S.

Dianthera
WATER-WILLOW.
Americana L.

PHRYMACEAE

Phryma
LOPSEED.
Leptostachya L.

PLANTAGINACEAE

Plantago
PLANTAIN.
aristata Michx. W. U. S.
lanceolata L. Europe
Rugelii Dcne.
Virginica L.

RUBIACEAE

Houstonia
BLUETS. INNOCENCE.
ciliolata Torr.
coerulea L.
purpurea L. S. E. U. S.

Cephalanthus
BUTTON BUSH.
occidentalis L.

Spermacoce
BUTTON-WEED.
glabra Michx.

Diodia
teres Walt.

Sherardia
BLUE FIELD MADDER.
arvensis L. Europe

Asperula
WOODRUFF.
odorata L.

Galium
BEDSTRAW. CLEAVERS.
Aparine L.
GOOSE-GRASS. Europe
circaezans Michx.
WILD LIQUORICE.
concinnum T. & G.
triflorum Michx.
SWEET-SCENTED.
tinctorium L.

CAPRIFOLIACEAE

Sambucus
ELDER.
Canadensis L.

Viburnum
ARROW-WOOD.
acerifolium L. N. E. U. S.
Opulus L.
CRANBERRY-TREE.
prunifolium L.
BLACK HAW.

Triosteum
HORSE-GENTIAN.
angustifolium L.

Symphoricarpos
SNOW-BERRY.
Symphoricarpos (L.) MacM.
(*S. vulgaris* Michx.

Lonicera
HONEYSUCKLE.
sempervirens L.
Sullivantii A. Gray

VALERIANACEAE

Valerianella
LAMB LETTUCE.
radiata (L.) Dufr.

Valeriana
VALERIAN.
pauciflora Michx.

DIPSACEAE

Dipsacus
TEASEL.
sylvestris Huds. Europe

CUCURBITACEAE

Citrullus
WATER-MELON.
Citrullus (L.) Small. Europe
(*C. vulgaris* Schrad.)

Cucumis
Melo L. Asia

Lagenaria
Lagenaria (L.) Cockerell
(*L. vulgaris* Ser.)

Cucurbita
PUMPKIN.
Pepo L.
verrucosa L.

Micrampelis
(*Megarrhiza*)
WILD BALSAM APPLE.
lobata (Michx.) Greene
(*Echinocystis lobata* T. & G.)

Sicyos
ONE-SEEDED BUR-CUCUMBER.
angulatus L.

CAMPANULACEAE

Campanula

BELLFLOWER.
Americana L.
aparinoides Pursh
rapunculoides L.

Legouzia

(*Specularia*)
VENUS' LOOKING-GLASS.
perfoliata (L.) Britton

LOBELIACEAE

Lobelia

LOBELIA.
cardinalis L.
inflata L.
leptostachya A. DC.
spicata Lam.
syphilitica L.

COMPOSITAE

Vernonia

IRONWEED.
fasciculata Michx. S. W. U. S.

Elephantopus

ELEPHANT'S-FOOT.
Carolinianus Willd.

Eupatorium

THOROUGHWORT.
ageratoides L. f.
WHITE SNAKE-ROOT.
coelestinum L.
MIST-FLOWER.
perfoliatum L.
BONESET.
purpureum L.
JOE-PYE WEED.

Grindelia

GUM PLANT.
squarrosa (Pursh) Dunal.
W. U. S.

Solidago

GOLDEN-ROD.
caesia L.
Canadensis L.
flexicaule L.
(*S. latifolia* L.)
patula Muhl.
serotina Ait.
ulmifolia Muhl.

Euthamia

(*Solidago* in part)
BUSHY GOLDEN-ROD.
graminifolia (L.) Nutt.
(*S. lanceolata* L.)

Aster

STARWORT, ASTER.
cordifolius L.
divaricatus L.
(*A. corymbosus* Ait.)
ericoides pilosus (Willd.) Porter
lateriflorus (L.) Britton
(*A. diffusus* Ait.)
longifolius Lam.
macrophyllus L.
Nova-Angliae L.
paniculatus Lam.
phlogifolius Muhl.
prenanthoides Muhl.
puniceus L. Red stalked A.
Shortii Hook.
vimineus Lam.

Erigeron

Fleabane.

annuus (L.) Pers.
Philadelphicus L.
pulchellus Michx.
(*E. bellidifolius* Muhl.)
ramosus (Walt.) B. S. P.

Antennaria

Everlasting.

fallax Greene
plantaginifolia (L.) Richards.

Anaphalis

margaritacea (L.) B. & H.

Gnaphalium

Cudweed.

purpureum L.
uliginosum L. Europe

Inula

Elecampane.

Helenium L. Europe

Polymnia

Leaf-cup.

Canadensis L.
Uvedalia L.

Silphium

Rosin-weed.

perfoliatum L.
Cup-Plant.
terebinthinaceum Jack.
Prairie Dock.
trifoliatum A. Gray S. E. U. S.

Ambrosia

Ragweed.

artemisiaefolia L.
Hog-weed.
trifida L.
Great Rag-weed.
integrifolia (Muhl.) T. & G.

Xanthium

Cocklebur.

Canadense Mill.
spinosum L. Trop. Amer.
strumarium L. Europe

Heliopsis

Ox-eye.

helianthoides (L.) B. S. P.
(*H. laevis* Pers.)

Eclipta

alba (L.) Haussk. Trop. Amer.

Rudbeckia

Cone-flower.

hirta L. W. U. S.
laciniata L.
triloba L.

Ratibida

(*Lepachys*)

Gray-headed Cone flower.

pinnata (Vent.) Barnhart

Helianthus

Sunflower.

annuus L. W. U. S.
decapetalus L.
giganteus L.
hirsutus Raf.
strumosus L.
tuberosus L.

Verbesina

(Includes *Actinomeris*)
Crownbeard.
alternifolia (L.) Britton
(*A. squarrosa*)
helianthoides Michx. S. W. U. S.

Coreopsis

Tickseed.

tinctoria Nutt.
tripteris L.
Tall Coreopsis.

Bidens

BUR-MARIGOLD.

bipinnata L.
connata Muhl.

SWAMP BEGGAR TICKS.

frondosa L.
laevis (L.) B. S. P.
(*B. chrysanthemoides* Michx.)
trichosperma (Michx.) Britton
(*Coreopsis trichosp.* Michx.)
tenuiloba (A. Gray) Britton

Galinsoga

GALINSOGA.

parviflora Cav. Europe

Helenium

SNEEZE-WEED.

autumnale L.
nudiflorum Nutt.

Dysodia

FETID MARIGOLD.

papposa (Vent.) A. S. Hitchc. S. W. U. S.
(*D. chrysanthemoides* Lag.)

Anthemis

CHAMOMILE.

Cotula L. Europe
nobilis L. Europe.

Achillea

YARROW. MILFOIL

Millefolium L. Europe

Matricaria

WILD CHAMOMILE.

matricarioides (Less.) Porter
(*M. discoidea* DC.) W. U. S.

Chrysanthemum

OX-EYE DAISY.

Leucanthemum L. Europe.
Parthenium (L.) Pers. Europe

Tanacetum

TANSY.

vulgare L. Europe.

Artemisia

WORMWOOD.

Abrotanum L. Europe
Absinthium L.
annua L. Asia
biennis Willd. N. W. U. S.
vulgaris L.

Erechtites

FIRE-WEED.

hieracifolia (L.) Raf.

Mesadenia

(*Cacalia*)

INDIAN PLANTAIN.

atriplicifolia (L.) Raf. W. U. S.
reniformis (Muhl.) Raf.

Senecio

GROUNDSEL.

obovatus Muhl.

Arctium

BURDOCK.

Lappa L. Europe

Carduus

(*Cnicus*)

COMMON OR PLUMED THISTLE.

altissimus L.
arvensis (L.) Robs. Europe
discolor (Muhl.) Nutt.
lanceolatus L. Europe
Virginianus L.

Onopordon

SCOTCH THISTLE.

acanthium L. Europe.

Adopogon
(*Krigia*)
DWARF DANDELION.
Carolinianum (Walt.) Britton
(*K. Virginica* Willd.)
Virginicum (L.) Kuntze
(*K. amplexicaulis* Nutt.

CICHORIACEAE

Tragopogon
SALSIFY.
porrifolius L. Europe

Taraxacum
DANDELION.
Taraxacum (L.) Karst. Europe
(*T. officinale* Weber)

Sonchus
SOW THISTLE.
arvensis L. Europe.
asper (L.) All. Europe
oleraceus L. Europe

Lactuca
LETTUCE.
Canadensis L.
sagittifolia Ell.
(*L. integrifolia* Bigel.
sativa C. Bauhin
GARDEN LETTUCE. Europe.
Scariola L. Europe.
spicata (Lam.) A. S. Hitchc.
(*L. leucophaea* A. Gray)
villosa Jacq.
(*L. acuminata* A. Gray)
virosa L.

Nabalus
(*Prenanthes*)
RATTLESNAKE-ROOT.
albus (L.) Hook.
altissimus (L.) Hook.
crepidineus (Michx.) DC.

Hieracium
HAWKWEED.
scabrum Michx.

Cichorium
Intybus L. Europe.

ARTICLE VII.—LIST OF MEDICINAL PLANTS, WILD OR CULTIVATED, GROWING IN THE VICINITY OF CINCINNATI, OHIO, WITH NOTES AS TO THE PARTS USED FOR MEDICINAL PURPOSES.

BY WALTER H. AIKEN.

The numbers refer to the parts used, viz:
1, root; 1b, bark of root; 2, stem; 2b, bark; 2c, underground stem; 3, leaves; 4, flowers; 4b, buds; 5, fruit; 6, whole herb; 7, sap; 8, resinous exudations; 9, excrescences.

Osmunda regalis L. 1
" cinnamomea L. 1
Adiantum pedatum L. 6
Pteridium aquilinum (L.) Kuhn 6
Equisetum hyemale L. 6
Larix laricina (Du Roy) Koch. 2b
" Europaea L. 8
Thuja occidentalis L. 3
Juniperus Virginiana L. 3, 9
Typha latifolia L. 1
Alisma Plantago-aquatica L. ... 3
Avena sativa L. 5
Hordeum vulgare L. 5
Agropyrum repens (L.) Beauv. 1
Acorus calamus L. 2c
Spathyema foetida (L.) Raf. .. 1, 5
Arisaema triphyllum (L.) Torrey 2c
Allium Cepa L. 2c
" sativum C. Bauhin. 2c
Erythronium Americanum Ker. 1, 3
Asparagus officinalis L. 2
Vagnera racemosa (L.) Morong 1
Trillium erectum L. 1
" sessile L. 1
Dioscorea villosa L. 2c
Iris versicolor L. 2c
Corallorhiza odontorhiza Nutt. 1
" Wisteriana Conrad 1
Juglans cinerea L. 1b, 3
" nigra L. 5
Populus balsamifera candicans (Ait.) A. Gray 4b
Populus grandidentata Mx. ... 2b
" tremuloides Mx. 2b
Salix nigra Marsh 2b, 4
" purpurea L. 2b
Ostrya Virginiana Mx. 2b
Quercus alba L. 2b
" rubra L. 2b
" velutina Lam. 2b
Ulmus pubescens Walt. 2b
Morus rubra L. 2b, 5
Humulus Lupulus L. 4
Cannabis sativa L. 4, 8
Urtica dioica Pursh 1, 3
Adicea pumila (L.) Raf. 3
Asarum Canadense L. 1
" reflexum Bich 1
Aristolochia serpentarium L. .. 1
Rumex acetosella L. 3
" crispus L. 1
" obtusifolius L. 1

Polygonum erectum L........ 6
" punctatum L...... 6
Fagopyrum Fagopyrum (L.) Karst 5
Chenopodium ambrosioides L.. 5
" Botrys L........ 5
Amaranthus hybridus L....... 3
Phytolacca decandra L......1, 3, 5
Saponaria officinalis L........1, 3
Alsine media L............... 6
Nymphaea advena Sol......... 1
Castalia odorata (Dry.) W..... 1
Magnolia acuminata L........ 2b
Liriodendron tulipifera L..... 2b
Hydrastis Canadensis L....... 1
Actaea alba (L.) Mill.......... 2c
Cimicifuga racemosa (L.)..... 1
Syndesmon thalictroides L. Nutt....................... 1
Hepatica acuta (Pursh.) Br.... 6
Ranunculus repens L.........2c, 6
" sceleratus L.....2c, 6
Podophyllum peltatum L.....2c, 1
Jeffersonia diphylla (L.) Pers.. 1
Caulophyllum thalictroides L. 1
Berberis vulgaris L 2b, 5
Menispermum Canadense L.... 1
Sassafras Sassafras (L.) Karst. 1b
Benzoin Benzoin (L.) Coult..2b, 5
Sanguinaria Canadensis L..... 1
Chelidonium majus L.........1, 6
Papaver somniferum L........ 5
Bicuculla Canadensis (Gol.) Mill...... 1
Sisymbrium officinale (L.) Scop.......................5, 6
Roripa armoracia (L.) A. S. H.. 1
Bursa Bursa-pastoris (L.) Britt. 6
Heuchera Americana L........ 1
Hydrangea arborescens L..... 1
Liquidambar styraciflua L..... 7
Hamamelis Virginiana L.....2b, 3
Porteranthus stipulatus (Muhl) Brit....................... 1b
Rubus villosus Ait............ 1b
Fragaria Virginiana Duch..... 5
Potentilla Canadensis L........ 1
Geum Virginianum L......... 1
Agrimonia mollis (T. & G.) Britt......................1, 3
Malus Malus (L.) Britt........ 2b
Prunus serotina Ehrh......... 2b
Amygdalus Persica L.........3, 5
Cassia Marylandica L.......... 3
" Chamaecrista L 3
Gymnocladus dioicus L. (Koch.) 5
Baptisia tinctoria (L.) R. & Br..1, 3
Melilotus alba Desv...........3, 4
" officinalis (L.) Lam..3, 4
Trifolium pratense L.......... 4
Robinia Pseudacacia L.......2b, 3
Geranium maculatum L....... 1
Oxalis stricta L............... 6
" violacea L 6
Linum usitatissimum L....... 5
Xanthoxylum Americanum L. 2b, 5
Ptelea trifoliata L............. 1b
Ailanthus glandulosa Desf..1b, 2b
Polygala senega L 1
" viridescens L......... 1
Ricinus communis L.......... 5
Euphorbia corollata Eng...... 1b
" maculata L......... 3
" Preslii Pursh....... 3
Callitriche Austini Eng........ 6
Rhus copallina L............2b, 5
" glabra L... ....2b, 5
" hirta (L.) Sudw........2b, 5
" radicans L 3
Ilex opaca Ait................. 3
Euonymus atropurpureus Jacq. 1b
Celastrus scandens L.......... 1b
Aesculus Hippocastanum L ... 1b
Impatiens aurea Muhl......... 6
" biflora Wal.......... 6
Ceanothus Americanus L 1b
Parthenocissus quinquefolia (L.) Pl....................2, 2b
Malva rotundifolia L.......... 6

Viola odorata L. 6
Oenothera biennis (L.) Scop. 2, 2b
Aralia racemosa L. I
Sanicula Marylandica L. I
Washingtonia longistylis (Torr.) Britt. I
Carum Carui L. 5
Daucus Carota L . . . . I, 5
Cornus Amonum Mill 2b
" florida L 2b
Monotropa uniflora L. I
Anagallis arvensis L. 3
Diospyros Virginiana L. 2b, 5
Fraxinus Americana L. 2b
" nigra Marsh. 2b
" quadrangulata Mx. . . 2b
Chionanthus Virginica L. . . . . . Ib
Ligustrum vulgare L. 3
Sabbatia angularis (L.) Pursh. 6
Frasera Carolinensis Walt. I
Apocynum androsaemifolium L. I
" cannabinum L. I
Asclepias incarnata L. I
" Syriaca L. I
" tuberosa L I
Ipomoea pandurata (L.) Mey. . . I
Polemonium reptans L. I
Cynoglossum officinale L . . . . . I, 3
Lappula Virginiana (L.) Gr. . . I
Mertensia Virginica (L.) D. C. 3
Verbena hastata L. I
" urticifolia L I
Scutellaria lateriflora L. 6
Marrubium vulgare L. 6
Nepeta cataria L. 3, 4
Glecoma hederacea L. 3
Leonurus Cardiaca L. 3, 4
Salvia lyrata L. 3
" officinalis L. 3
Hedeoma pulegioides L. 6
Melissa officinalis L. 6
Koellia pilosa (Nutt.) Britt. . . . 6
" Virginiana (L.) McM. . . 6
Lycopus Virginicus L. 6
Mentha piperita L. 6
" spicata L. 6
Collinsonia Canadensis L. 6
Solanum Dulcamara L. . . . . I, 2
" tuberosum L. 6
" nigrum L. 3
Lycopersicon Lycopersicon (L.) Karst. 6
Datura Stramonium L. 3, 5
Nicotiana Tabacum L. 3
Verbascum Thapsus L. 3, 4
Scrophularia Marylandica L. . . I, 3
Chelone glabra L 3
Veronica peregrina L. 3
Leptandra Virginica (L.) Nutt. I
Digitalis purpurea L. 3
Leptamnium Virginianum (L.) Raf 6
Catalpa Catalpa (L.) Karst. . . . 2b
Plantago Rugelii Dcne. . . . . I, 4
Cephalanthus occidentalis L . . 2b
Galium Aparine L. 6
Sambucus Canadensis L. 4, 5
Viburnum opulus L. 2b
" prunifolium L. . . . . . Ib
Lobelia inflata L. 3, 5
Vernonia fasciculata Mx I
Eupatorium perfoliatum L. . . . 3, 4
" purpureum L. I
Grindelia squarrosa (Pursh.) Dunal. 3, 4
Aster puniceus L. I
Erigeron ramosus (Wal.) B. S. P. 6
" Philadelphicus L 6
Anaphalis margaritacea L (B. & H.) 3
Inula Helenium L. I
Polymina Uvedalia L. I
Silphium perfoliatum L. I
Ambrosia artemisiaefolia L. . . . 3
" trifida L 3
Xanthium spinosum L. 6
Rudbeckia laciniata L. 6
Helianthus annuus L 5

Bidens bipinnata L. 1, 5
" connata Muhl. 1, 5
" frondosa L 1, 5
Helenium autumnale L. 6
Achillea Millefolium L. 6
Chrysanthemum Leucanthemum L. 3, 4
Chrysanthemum Parthenium (L.) Pers. 6
Tanacetum vulgare L. 6
Artemisia vulgaris L. 3, 4
Erechtites hieracifolia (L.) Raf. 1, 6
Arctium Lappa L. 1, 5
Cnicus arvensis (L.) Robs. 1
Taraxacum Taraxacum (L.) Karst 1
Lactuca sativa L 7
" virosa L. 7
Nabalus albus (L.) Hook. 6

ARTICLE VIII.—ORTHOGRAPHY OF NAMES OF THE NAIADES.

By Josua Lindahl (Cincinnati).

The current literature on the fresh-water mussels, more than any other branch of zoölogy, is so filled with glaring orthographic blunders, that it seems necessary that something be done, without further delay, toward establishing a fixed basis for spelling the scientific names of the 1,200 species and varieties which, according to Simpson's Synopsis*, belong to the world's fauna of the said group. More than one-fifth of them are now generally written wrong, in defiance of the rules for the orthography of such names. These rules are set down in a series of Canons and Recommendations in the *Code of Nomenclature*, adopted first by the American Ornithologists' Union (New York, 1892). The following have a particular bearing on the corrections which I am going to present.

> Canon VIII.—Proper names of species, and of sub-species or "varieties," are single words, simple or compound, preferably adjectival or genitival, or taken as such, when practicable agreeing in gender and number with any generic name with which they are associated in binominal or trinominal nomenclature, and written with a small initial letter.
>
> Canon XXX.—Specific names when adopted as generic are not to be changed.
>
> Canon XL.—The original typography of a name is to be rigidly preserved, unless a typographical error is evident.

*Synopsis of the Naiades, or Pearly Fresh-Water Mussels. By Charles Torrey Simpson, Aid, Division of Mollusks. From the Proceedings of the United States National Museum, Vol. XXII, Washington, 1900.

Remarks.— . . . . . . restrict the emendation of names to the correction of obvious or known typographical errors involving obscurity.*

RECOMMENDATION I.—The rules of Latin orthography are to be adhered to in the construction of scientific names.

Remarks . . . . For instance, the names which modern authors have written *Aipunemia* . . . *poiocephala*, must, according to the laws of etymology, be spelt *Æpycnemia* . . , *pœocephala*.

Simpson gave four different forms to the name of one of the new genera, described in his "Synopsis," viz.: *Schistodesma* (pp. 506 and 514). *Shistodesmus* (pp. 803 and 804), *Shistodesma* (p. 1036), and *Schistodesmus* (Table of Contents, p. vi of the separate edition of the Synopsis, while the Table of Contents of the whole volume of Proceedings has, on p. vii, *Shistodesmus*). The spelling of the first syllable as "*Shi*" is an impossibility in a Greek word, and the above Recommendation I demands that it be written "*Schi*." MR. BRYANT WALKER (in letters) urges, correctly, that the forms used previous to page 803, where the species is first defined, shall be considered as *nomina nuda*. The name, properly transliterated, must therefore stand as *Schistodesmus*.

RECOMMENDATION II.—In latinizing personal names only the termination should be changed, except as in cases provided for under Recommendation IV.

Remarks.— . . . . . This recommendation . . . . , is particularly to be observed in many names ending in *a*, the genitive of which should be *æ*.

RECOMMENDATION IV.—Names adopted from languages . . . . containing characters not represented

*Such an *error involving obscurity*, albeit the fault of the author rather than of the typographer, we find in the name of *Quadrula keineriana*, dedicated by Lea to: "Mr. L. C. Keiner, the author of *Iconographie des Coquilles Vivantes*." But that author's name was L. C. KIENER. A similar error occurs in Lea's *Anodonta jewittiana*, named in honor of Col. E. Jewett.—Would anybody hesitate to correct such *lapsus pennæ?*—See the following Recommendation II,

in the Roman alphabet . . . . should be rendered by the corresponding Roman letters or combinations of letters.

Remarks.—The German *ö* . . . may be rendered . . . by . . *œ*.

The above canons and recommendations may be supplemented by the following rule, for certain cases not considered by the authors of the Code:

SUPPLEMENTARY RULE.—When the gender of a word used as a generic name can not be decided by any etymological rule, *priority of use* shall settle the question.

Remarks.—There are two generic names, *Lampsilis* and *Glabaris*, to which no linguistic rules can be applied for determining their gender, except so far that neither of them can be a neuter. Nor is there any rule in the A. O. U. Code by which it can be decided whether they are to be considered as masculines or feminines. But Rafinesque, who invented the name *Lampsilis*,* described under that new genus three species, one of which, *L. ovata*, shows that he meant it to be a feminine. William Stimpson, in his "Shells of New England," used it likewise as feminine, and the various later authors who have treated it as a masculine are in error.

J. E. Gray coined the name *Glabaris* without ever using it coupled to any specific name. The first author who used it in such combinations was Von Ihering. In his "Najaden von S. Paulo," 1893, he referred half a score of species to that genus using the name as feminine, and this priority of use must be accepted as decisive.

Professor Walter Miller, now of the Tulane University in New Orleans, published, some years ago, a most excellent guide for the compounding of names from Latin and Greek roots,† which ought to be carefully perused by Zoölogists and

*Monographie des Coquilles Bivalves Fluviatiles de la Rivière Ohio. Bruxelles, 1820.

†Scientific names of Latin and Greek Derivation.—Proc. Cal. Ac. Sc., Third Ser, Zoology, Vol. I., No. 3.—San Francisco, 1897,

Botanists. He says (p. 127): "If the final member of a nomen compositum is a noun, the compound will have the form and gender and inflectional stem of that noun," and further (p. 129): "The gender of the genus name, when it is made a noun, depends not on the termination, but upon the gender of the noun forming the final element of the compound."

This rule is, however, not easily applied in cases where the compound has been so distorted, that it is hard to tell whether to consider the word as a genuine noun or some kind of malformed adjective made to pose as a noun. Such examples may be found in *Anodonta*, *Alasmidonta*, *Symphynota* and *Mycetopoda*. To treat them as masculines because the final elements of each of them is a masculine noun, it would be futile to attempt. We must leave them as feminines. But the rule is fully applicable to all names terminating in *opsis*, which must be feminines (ἡ ὄψις) and those in *bema*, *desma*, *branchus* and *rhynchus*, all of which are neuter—τό βῆμα, τό δέσμα a band, (not from ἡ δέσμη, a bundle), τά βράγχια, gills, (not from ὁ βράγχος, hoarseness), and τό ῥύγχος.

Many of our conchologists have been puzzled how to handle specific names with such terminations as we find in adjectives, and the mistaken idea that all specific names are to be considered as adjectives has led them occasionally to inflect these nouns as adjectives. *Unio clava* has often been written *U. clavus*, whereby the intention of the original author to compare its shape to that of a *club* was perverted so as to make it look like a *nail*. The name *Unio calceolus*, suggesting the resemblance of the shell to a slipper, was changed to *Margarita calceola*, which suggests nothing at all. While such inflections are obviously wrong, it might appear reasonable, when the noun denotes a living being and the Latin language has two forms for resp., male and female individuals, that the form should be used which corresponds to the gender of the generic name. *Unio corvunculus* may thus become *Lampsilis corvuncula*. But a consistent application of such a rule may lead to a perversion of the significance of the original name. For example : the European stag-beetle (*Lucanus*

cervus) has its name from the striking resemblance of its mandibles to the antlers of a stag (*cervus*). If that species should have to be transferred to another genus, *F.*, which happens to be a feminine noun, and we call the said stag-beetle *F. cerva*, the fitness of the original appellation would be sadly destroyed, as the doe (*cerva*) has no antlers. The only safe rule for the orthography of a specific name, when the species shall be shifted from one genus to another, is therefore : *leave all nouns unaffected by the gender of the generic name.*

In many specific names ending on *ensis*, after a geographical name ending with a vowel, that vowel is elided, while in others it is not, and, in some of the latter, *ae* is written as a diphthong, in others as two distinct vowels. Professor Miller, whom I have consulted on this question, writes me: "Before the suffix *ensis*, elision is *imperative*, except in the case of *y*, which is so often a consonant that it is always so treated. The words suggested would accordingly appear as *bhamensis*, *chalcensis*, *cincinnatensis*, *demerarensis*, *monroensis*, *ohiensis*, *tampicensis*, *omensis*, *topekensis*, *ujijensis*, *tavoyensis*, *etc.*"

In the following list of corrected names I have used Simpson's Synopsis as the basis. The rest of the names adopted, or given, by Simpson may be considered as unassailable under the protection of the code. Fully aware of the danger of doing mischief by any unnecessary change of a published name, I have submitted proofs of this paper to five eminent judges on questions of nomenclature, and, in every instance, I have abided by the verdict of the majority of them—even in the case of *Dromus dromas*, which, according to Canon XXX, certainly ought to be *Dromas dromas*. I beg herewith to express my sincere gratitude for the help thus rendered by DRS. WM. DALL, THEODORE GILL, LEONHARD STEJNEGER and VICTOR STERKI and MR. BRYANT WALKER.

List of Corrected Names.

Lampsilis (fem.).

ventricosa,
" satura,
excavata,
binominata,
cariosa,
ovata,
ochracea,
splendida,
perpasta,
clarkiana,
multiradiata,
brevicula,
" brittsi,
biangulata,
luteola,
" rosacea,
radiata,
" conspicua,
hydiana,
approxima,
contraria,
porphyrea,
straminea,
reeviana,
ligamentina,
" gibba,
orbiculata,
tæniata,
picta,
punctata,
bracteata,
venusta,
fallaciosa,
recta,
nasuta,
subrostrata,
lienosa,
" unicostata,
propria,
punicea,
obscura,
vaughaniana,
constricta,
apicina,
nigerrima,
fatua,
planicostata,
nebulosa,
muehlfeldiana,
amœna,
tenera,
sima,
planca,
subangulata,
kirklandiana,
perpurpurea,
vibex nigrina,
suda,
villosa,
pellucida,
papyracea,
singleyana,
texasensis compressa,
parva,
haliana,
germana,
mæsta,
paula,
pulla,
alata,
" poulsoni,

rovirosæ,
purpurata,
umbrosa,
tampicensis,
livida,
explicata,
alienigena,
metallica,
lævissima,
amphichæna,
scutulata,
paludosa,
argyrata.

Hyriopsis (fem.).
bialata,
myersiana,
pinchoniana,
vagula,
caudiculata.

Lepidodesma (neu.).
aliger.

Nephronaias (fem.).
medellina,
reticulata
scamnata,
æruginosa,
rugulosa,
persulcata,
plicatula,
ravistella,
vellicata,
mellea.

Ptychobranchus (neu.).
clintonense,
foremanianum,
trinacrium.

Dromus (mas.).
dromas,

Anodonta (fem.).
wahlamatensis,
luculenta.
aurea,
curvata,
picta,

Gabillotia (fem.).
euphratica churchilliana.

Unio (mas.).
platyrhynchoideus,
congareus.

Alasmidonta (fem.).
calceolus

Pleurobema (neu.).
maculatum,
holstonense,
bournianum,
edgarianum,
ravenelianum,
oviforme,
ornatum,
appressum,
validum,
swordianum,
subglobatum,
crudum,
barnesianum,
pudicum,
bigbyense,
decisum,
chattanoogense,
interventum,

murrayense.
curtum,
taitianum,
perovatum,
stabile,
troschelianum,
irrasum,
altum,
hartmanianum,
instructum,
verum,
rubellum,
furvum,
hanleyanum,
flavidulum,
bulbosum,
reclusum,
brumbyanum,
strodianum,
patsaligense,
favosum,
lenticulare,
litum,
georgianum,
pyriforme,
modicum,
striatum,
gibberum,
fascinans rhomboideum,
argenteum,
" pannosum,
connasaugense,
breve,
" subellipticum,
planius,
estabrookianum,
striatulum,
amabile,
cicatricosum.

Quadrula (fem.).
aspera,
pustulosa kieneriana,
coccinea paupercula,
polysticto-scripta,
polysticta,
microsticta,
triclavus,
cornuum-lunæ cinnamomea.

Schistodesmus (mas.).

Cuneopsis (fem.).
capitata.

Nodularia (fem.).
soboles,
æquatoria,
caffra,
" africana,
" vaalensis,
hygapana.

Pseudodon (mas.).
ellipticus,
cambodiensis.

Parreysia (fem.).
wynegungensis,
vulcanus,
burmana,
gowhattensis,
ngesiana,
hypsiprymnus,
chinensis squamosa.

Ptychorhynchus (neu.).
pfisteri inspiratum,

mediastinum,
apicellatum,
schomburgkianum,
murinum (see Errata, Synopsis, p. viii)

Ctenodesma (neu.).
borneense.

Tetraplodon (mas.).
quadrilaterus.

Castalina (fem.).
psammœca.

Diplodon (mas.).
rhyacœcus,
wagnerianus,
æthiops piricicabanus,
demerarensis,
hylæus.

Spatha (fem.).
wahlbergi bourguignati.

Monocondylæa (fem.).
inermis.

Glabaris (fem.).
patagonica.
" felix,
crassa,
rubicunda,
rotunda,
membranacea,
crispata,
philippiana,
luteola,
schomburgkiana,
cylindracea,
puelchana,
limnœca,
lucida,
trautwiniana,
trapezialis,
" anserina,
" exotica,
" scripta,
" moretoniana,
" cygnæiformis.
radiata,
simpsoniana,
sinuosa,
glauca,
" sinaloensis,
umbonata,
jewettiana,
forbesiana,
trigona,
elongata,
lingulata,
mortoniana,
longina,
leotaudi,
tenebricosa,
pastasana,
schrœteriana,
obtusa,
liturata,
falsa.

ARTICLE IX.—PISOLITIC BARITE.

By Herman Wuestner,

Curator of Minerals, Cincinnati Society of Natural History, Cincinnati.

Mr. B. P. Thrasher, residing at present at Saratoga, Texas, on October 24th last, sent to the Museum of the Cincinnati Society of Natural History, a few pellets of a mineral labeled as follows: "*From water strata, 1350 feet below sur face, at Saratoga, Hardin Co., Texas. Several barrels of them blown out by gas in boring for oil.*"

The specimens being turned over to me for examination, blowpipe analysis soon proved these pellets to consist of barite, a mineral which has never hitherto been recorded as occurring in pisolitic form.

Dr. Josua Lindahl, Director of the Museum, wrote at once to Mr. Thrasher, asking him to send more abundant material for examination. In response, Mr. Thrasher forwarded about four ounces of the same material, declaring this was all that remained, all the rest of it having been left on the ground, whence it had now been washed away beyond recovery. He also supplemented his previous statements by giving the temperature of the water that brought up the pellets as 120° F. (about 49° C.), adding that this was the only instance where such material had been obtained at any oil boring in that region.

Among the pellets were found a few fragments of a brown fossil of a porous, sponge-like structure and saturated with petroleum. These, too, proved to consist mainly of barite. One of them was sent to Dr. E. O. Ulrich, of the U. S. Geological Survey, Washington, D. C., for possible indentification. Dr. Ulrich, kindly replying, states that the specimen is "a fragment of one of the reef building corals," and that

"the occurrence of such corals in the Miocene of Texas is well known." He had further consulted his colleague, DR. T. W. VAUGHAN, who said that it "may be an Acroporid coral, but too poorly preserved for definite determination" Fig. 1 shows photograph of one of these fragments, enlarged 8 diam.

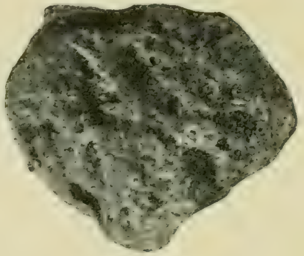


FIG. 1.

The pellets in a subsequent chemical analysis (see below) were shown also to contain calcium sulfate and strontium sulfate in weighable quantities. They have evidently been formed around fragments of the coral as a nucleus, investing such fragments with concentric layers of barium (calcium and strontium) sulfate.

Dr. Ulrich, in his communication, suggests that "the sulfate of barium covering may be a metasomatic replacement of a similar original calcium carbonate investment. Such a replacement may, as in this case, extend to and include the nucleus."

As to the structure of the pellets, a transverse section reveals tubes radiating from the nucleus like spokes of a wheel (see Figs. 2–4), imbedded in a series of two or three incrusting concentric shells, surrounded by a series of cortical layers, into which the radiating tubes do not extend, though some radiated structure is discernible in the microscopic section of these cortical layers also. It seems that after the deposition of the inner shells, the process was interrupted, and the outer shells were formed at a later period.

The inner layers are of a bluish white tint and quite compact; the cortical layers are creamy white and of less compact

FIG. 2.

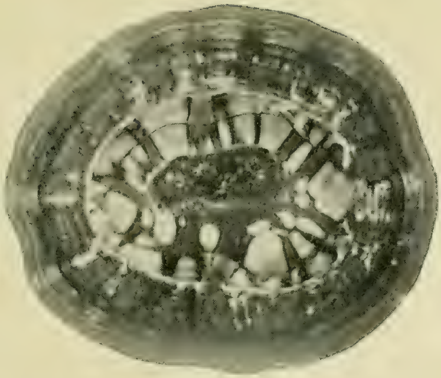


FIG. 3.

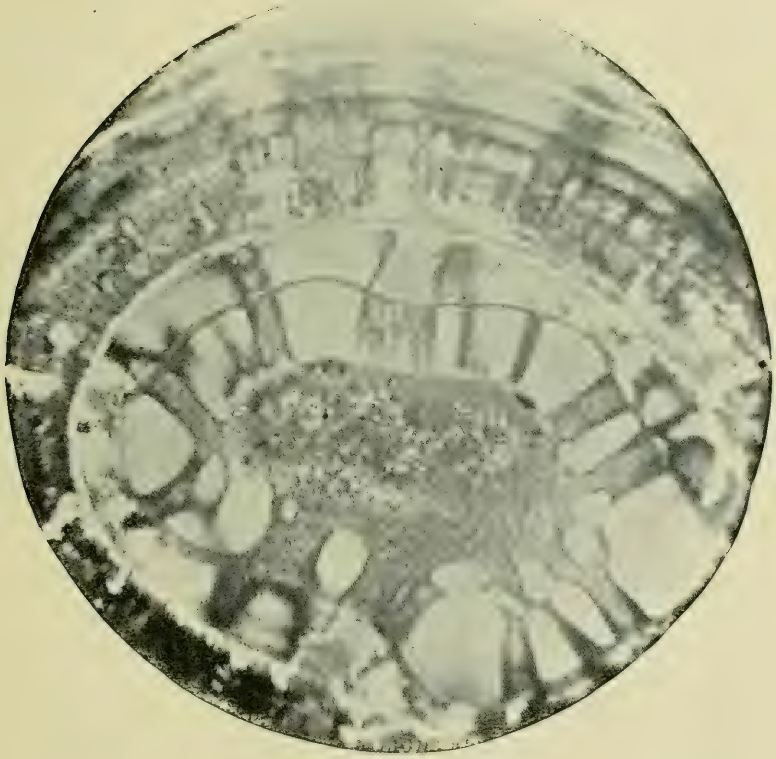


FIG. 4.

Fig. 2.—Section of a round pellet, x 10 diam.
Fig. 3.—Section of a spheroidal pellet, x 10 diam.
Fig. 4.—A portion of the same section as in Fig. 3, x 25 diam.

Note.—Figs. 2 and 3 are slightly reduced from the size of the original photo-micrographs. The original photo-micrograph used for Fig. 4 was enlarged in the half-tone from 18½ to 25 diam. The negative was taken under Obj. 1, Oc. 1 (Winckel).

structure. When a transverse section of a pellet is immersed for a moment in carmine ink and then washed in water, the cortical layers will be seen to have readily absorbed the ink, while the inner layers are not affected by the staining fluid. Still, upon crushing, even the cortical layers present a considerable degree of hardness.

The pellets are of a strikingly uniform appearance. With the exception of the smallest ones, on which the incrustation has just commenced, and which therefore still present the irregular form of the nucleus, they are in most cases nearly spherical, rarely spheroidal or discoidal.

About one-third, in bulk, of the whole quantity consists of broken pellets, the remaining two-thirds being unbroken, and the total number of these is 456, varying in size, weight and form as follows:

25 pellets, diameter 2.0 to 4.0 mm, form irregular nodular; cortical layer thin, or none; ends of tubuli often plainly marked on the surface, but rarely with an open lumen. Weight of the smallest specimen .09 gm.

37 pellets, diameter 4.0 to 4.5 mm, form approximately spherical. Average weight .22 gm.

384 pellets, diameter 4.5 to 5.0 mm, nearly spherical. Average weight .24 gm.

10 pellets, diameter more than 5 mm in one direction, not over 4.5 mm in another direction. These 10 specimens are either prolate or oblate spheroidal in shape. The largest one, an oblate spheroid, having diameters of 4 and 7.5 mm, weighs .40 gm.

The largest fragment of the coral (Fig. 1) measures 8 mm. in width, but only 3 mm in thickness, and weighs .13 gm; another, 6 mm. in width, has a thickness of 3.5 mm. The others a still smaller.

In order to account for the uniformity of the round pellets and the scarcity of the flat ones, we may suppose that, in tapping the underground repository of these peculiar formations, the upward stream of water carried only those pellets which did not exceed a certain maximum weight. As to the flat pieces, whose weight exceeds that limit, it seems that the

stream brought to the surface only those few which happened to present their flat surface in a direction perpendicular to that of the upward pressure. The others, tilted, did not present as large an *effective* surface, i. e., did not sustain the same lifting force.

The manner in which these pellets were formed is probably a matter of conjecture. In this particular case, it is not likely that these bodies were carried by a subterranean stream, because, as Mr. Thrasher states, no such material has been encountered before in deep borings which have been carried on in neighboring localities.

It is quite probable, therefore, that the pellets are the product of a confined locality, and were formed by a subterranean spring carrying barite in solution, much in the same manner as the pisolitic aragonite in the Sprudel of Carlsbad, Bohemia, is believed to be formed. The coral fragments resulting from the breaking up of an underground deposit, were carried up by the spring, and each fragment was kept spinning around while layer after layer of barite was deposited around it, a process which continued until the pellets grew too heavy to be kept in suspension.

The radiating tubuli may then be the result of the centrifugal force by which the oil contents of the nucleus were constantly brought to the open pores on the surface, preventing deposition of barite within the pores. Each additional coating encroached, however, on the lumen of each tubule, causing them to grow narrower as their length increased.

Whether the coral nucleus and the incrusting shells, originally, consisted of barite, or of calcite subsequently changed by a metasomatic substitution of barite, is a question which it may not be possible to decide as long as the original deposit of the material remains inaccessible. A similar substitution has taken place in the oolite from Centre County, Pa., where silica has taken the place of calcium carbonate.

DR. S. WALDBOTT, of the Ohio Mechanics Institute, has most kindly made a quantitative analysis of the materials herein described, and submits the following results :

	Shell .8461	Nucleus .4084	Coral .0617
Volatile Hydrocarbons.........	.77%	.98%	1.62%
Volatile at red heat.............	.23	.20	3.08
Ba SO_4	92.73	92.59	83.4
Ca SO_4	3.31	2.79	undetermined
Sr SO_4	1.36	1.04	none
Undetermined (iron, unburned carbon).....................	1.60	2.40	
	100.00%	100.00%	

*After removing nuclei from several broken pellets.
†Taken out of the same broken pellets.

Specific gravity of pellets, 3.99.

In order to ascertain the geological age of the stratum whence the pellets were ejected, Dr. Lindahl secured, through the courtesy of Mr. Thrasher, a copy of the boring log, which contained the following note : "1322 to 1375 feet : Oil, sand, ... Formations (pellets) came from 1350 feet. Water temperature 120°."

Comparing the log with data published in U. S. G. S., Bulletin No. 212 ("Oil Fields of the Texas-Louisana Gulf Coastal Plain. By Dr. C. W. Hayes and William Kennedy), Dr. Lindahl came to the conclusion that the strata at the above depth might reasonably be guessed to belong to the lowest Neocene beds, "3 d" of the section on page 20 of the said Bulletin, and Dr. Hayes, to whom the log was submitted, confirmed the conjecture in the following words : "This is as near as any one else could guess.—C. W. H." The Bulletin states that sands of those beds "carry fossils of Miocene age." As remarked above, Drs. Ulrich and Vaughan considered the brown particles as fragments of a Miocene coral.

For the photo-micrographs, here reproduced in half-tone (Figs. 2–4), I am greatly indebted to DRS. M. L. HEIDINGSFELD and A. J. MARKLEY, of Cincinnati. I also wish to express my gratitude to DR. JOSUA LINDAHL, Director of the Museum of the Cincinnati Society of Natural History, for his kind and unselfish co-operation in connection with the subject herein presented.

ARTICLE X.—ECOLOGICAL NOTES ON SOME COLEOPTERA OF THE CINCINNATI REGION, INCLUDING SEVEN NEW SPECIES.

By Charles Dury (Cincinnati).

Hamotus batrisioides *Lec.*

I have taken a number of this curious species by sifting the decayed and honeycombed interior of a standing dead tree. Both males and females were taken. I notice that the antennal club of female is smaller than that of the male. April 2 to May 2, Cincinnati, Ohio.

Homœusa expansa *Lec.*

This flat little species was sifted from a nest of pale ants, *Lasius claviger*, May 7.

Scopæopsis duryi *Casey.*

Sifted from the debris of a patch of withered fungus, *Agaricinæ*; three specimens. See Revision of American Pæderini. Casey. Trans. St. Louis Acad. 1905, vol. xv., No. 2, p. 216.

Ptinidium lineatum *Lec.*

This very minute species lives under the decaying bark of the "Honey Locust," in moist places. I have also sifted it from the debris at the base of these trees. May 4.

Anamorphus pusillus *Zimm.*

One specimen, July 7, taken feeding on fungus on beech log in company with *Rymbus minor*, which species it resembles in an astonishing manner.

Colyphus melanopterus **n. sp.**

Jet black, shining, except the thorax, which is rose pink, and the mouth and front, which are pale testaceous. Head

with scattered, fine punctures. Front with a broad crescentic impression, interrupted at middle. Eyes large, prominent. Antennæ eleven-jointed, without club, the joints gradually becoming wider to the tenth. Thorax with a broad black furcate mark extending from base to apex. Elytra coarsely cribrate and but little wider than thorax; widest about the middle, with prominent humeri. Body sparsely covered with erect black hairs. This species comes nearest *Colyphus furcatus* Sch., but is longer, much less hairy, the elytra are more shining and immaculate jet black. 8 mm. Cincinnati, Ohio. As defined by Mr. Gorham in Biologia, vol. iii., p. 2, this species belongs in his "Sec. A." I took one specimen while sweeping low vegetation in river bottom, July 5, 1905. I was very much surprised to see a representative of this genus so far north as Cincinnati.

PTILINUS RUFICORNIS *Say.*

May 20, 1905, I saw a maple stump that had a large flat sliver sticking up on one side. Into this a number of this species were cutting round holes. Many of them were half buried, leaving the posterior end sticking out of the hole. All were females. Until late in June they were at work here, and also on the wood of a split beech tree. I never take males in such a situation, but get them by beating dead branches. The male is much rarer than the female.

ODONTOSPHINDUS DENTICOLLIS *Lec.*

June 11, 1905, I took this species eating a dark brown powdery fungus that was growing on a poplar-log. *Sphindus americanus* Lec lives in same fungus. *Americanus* is abundant, *denticollis* is rare, and *Eurysphindus hirtus* Lec. is very rare here.

LACHNOSTERNA VEHEMENS *Horn.*

Twenty-two males of this species were taken flying about electric lights. Superficially it resembles *L. fusca* very closely, but the curved and hooked inner spur of hind tibia and the broad angulation of hind femur distinguish it. The types

were from Kansas. It is a very abundant species here, but no females have yet been taken.

CRIOCERIS ASPARAGI *Linn.*

The first specimen I have seen from Cincinnati of this introduced species was taken July 7, 1905, on Walnut Hills, by Miss Anette Braun.

NEOBROTICA (GALERUCA) DORSATA *Say.*

In a note by me in Ent. News for February, 1904, p. 53, I mention the occurrence of this beautiful Chrysomelid. Further search shows the thing to be abundant, and that its plant is perhaps the "Spiderwort" *Tradescantia Virginica.* I failed to find the larvæ, but the stems of the plant were, many of them, eaten out by some large larvæ. I could not find any evidence that they had eaten the roots, as does *Diabrotica* on other plants. Wherever I found the "Spiderwort," there I found the beetles. In a large patch of the plant, as late as July 22, 1905, I found them common, though very wild. I netted forty-three; all were females, the males being entirely gone at this date. The curiously modified male antennæ suggest that the species is a *Neobrotica.*

EPITRIX HUMERALIS **n. sp.**

About the size and proportions of *Epitrix fuscula* Crotch, but with coarser punctures on elytra. Ante-basal impression well marked. Color rufous with a feebly defined piceous cloud on disk of elytra. The humeral umbones with a pale spot, not sharply defined. Legs rufotestaceous. Length 2.5 mm. Three specimens from Cincinnati, O., one from Indiana and one from Kansas (Mr. Knaus).

CREPIDODERA ÆSCULI **n. sp.**

Allied to *Crepidodera rufipes*, but averages more slender, color of adult (including thorax) always dark piceous green, shining. Legs pale as in *rufipes.* Immature specimens paler, but always showing the green reflections. Thorax more distinctly punctured than rufipes. Length 3.5 mm. Occurs

abundantly on the "Buckeye," *Æsculus glabra*. *Crepidodera rufipes* occurs on the common locust *Robinia pseudacacia*.

PHYLLOTRETA LINDAHLI **n. sp.**

Elongate oval, convex, black, shining. Thorax wider than long, minutely alutaceus. Punctures fine, becoming coarser towards base. Elytra, wider at base than thorax, with humeri rounded. Disk coarsely punctured, with a faint strial arrangement. Tibia, tarsi and antennæ (except the last four joints of antennæ, which are piceous) pale.

Male characters.

Last ventral segment rounded at tip with a deep rounded depression, which extends forward in triangular shape through the entire length of the penultimate segment. In bottom of the depression is a groove extending its length. There are two minute tubercles at bottom of depression near apex of last segment.

Female characters.

Last ventral segment with a shallow fovea near tip. Obliterated in one specimen.

Four specimens 2.5 mm. Cincinnati, Ohio, May 30. This species belongs in series "B." *Phyllotreta* of Horn's paper on Halticini, Trans. Amer. Ent. Soc. xvi, and comes nearest *lewisii*. Dedicated to that industrious naturalist, Dr. Josua Lindahl.

EUSTROPHUS BRUNNEIMARGINATUS **n. sp.**

Oval, convex, moderately attenuate posteriorly. Body above black, sparsely pubescent. Head rufous, coarsely punctured. Eyes very narrowly separated. Thorax finely punctured, and with a broad brown marginal band, extending around the front from one hind angle to the other. This band is rather densely pubescent with fulvous hairs. Elytra striato-punctate, with a similar brown band extending around margin from one humerus to the other. Beneath, including legs, rufous, rather finely punctured. The punctures of mesosternum and ventral segments being ocarser than those of pro-

notum. The sculpture is rather coarser than in *Eustrophus bicolor*. Prosternum is not prolonged behind coxæ. Posterior tibiæ have transverse ridges, as in *E. bicolor*. As compared with *bicolor* this species is smaller, broader for its length, less shining, much less attenuate behind, less distinctly striate, with finer punctures in striæ, and with the fulvous border. Antennæ as in bicolor. Two specimens, Kentucky, near Cincinnati, Ohio, 4.8 mm. and 3.7 mm. long.

Mordellistena delicatula **n. sp.**

Elongate, very slender, piceous in color, with front of head, mouth parts, front and middle legs and antennæ pale rufotestaceous. The elytra thickly covered with rather coarse, sage green pubescence. Tibia with two ridges, anterior one extending across the outer face of the tibia. First tarsal joint with three, second with two oblique ridges. Length 3.3 mm. Seven specimens, Cincinnati, Ohio. The most slender species I have seen. The bright shining sage green pubescence fades out to silvery in old specimens. From the description I had always thought this was *splendens* Smith. But after seeing some of that species collected at Cameron, La., by Prof. Hine, and, comparing with the types in national museum, I see it is quite different.

Acroschismus

Acroschismus is a generic name proposed by Mr. W. D. Pierce for some new species of the family *Stylopidæ*, specimens of which I have bred here from parasitized wasps. I have taken three distinct species, for which Mr. Pierce proposes the names in following list (Art. XI.). Descriptions will be given in a monographic paper shortly to be issued by him.

Cataspastus conspersus *Lec.*

Occurred by hundreds on "Prickly Ash" (*Xanthoxylum*) May 5.

Canistes schusteri *Csy.*

I took two of this very rare species July 12, 1905. They were standing high up on their clumsy legs in a patch of dark

colored fungus which was growing on the underside of a beech log in thick woods. They were gnawing at the fungus.

IDIOSTETHUS SUBCALVUS *Lec.*

Occurs in great numbers in the flowers of *Hydrophyllum appendiculatum.* May. I have been unable to find its larvæ.

PSOMUS POLITUS *Csy.*

Occurs commonly on ash sprouts (*Fraxinus americana*) June 1 to 25.

ARTICLE XI.—ADDITIONS TO THE LIST OF CINCINNATI COLEOPTERA.

By Charles Dury.

In Article V. of this volume* I have enumerated 2,031 species of Coleoptera observed near Cincinnati. In the following Supplementary List 209 species are given, making a total of 2,240 species. I have yet more than fifty unidentified species. I think 2,500 or more species will eventually be found here.

CICINDELIDÆ.

Cicindela duodecimguttata *Dej.*

CARABIDÆ.

Cychrus nitidicollis *Chev.*
Scarites substriatus *Hald.*
Dyschirius globulosus *Say.*
Aspidoglossa subangulata *Chd.*
Bembidium guexi *Chd.*
  postfasciatum *Ham.*
  dentellum *Thunb.*
  dilatatum *Lec.*
Tachys corruscus *Lec.*
Pterostichus purpuratus *Lec.*
Stolonis ulkei *Horn.*
Badister flavipes *Lec.*
Apristus subsulcatus *Dej.*
Chlænius laticollis *Say.*
  solitarius *Say.*
Gynandropus hylacis *Say.*
Selenophorus pedicularis *Dej.*
Harpalus autumnalis *Say.*
Acupalpus carus *Lec.*

SILPHIDÆ.

Aglyptus lævis *Lec.*

HYDROPHILIDÆ.

Cercyon navicularis *Zimm.*
  flavipes *Fab.*
  analis *Payk.*

SCYDMÆNIDÆ.

Eutheia americana *Casey.*

PSELAPHIDÆ.

Hamotus batrisioides *Lec.*
Decarthron abnorme *Lec.*
  exsectum *Brend.*
Batrisus virginiæ *Casey.*
Euplectus congener *Casey.*

STAPHYLINIDÆ.

Falagria quadriceps *Lec.*
Xenodusa cava *Lec.*
Homœusa expansa *Lec.*
Oxypoda opacula *Fauv.*
Myllæna infuscata *Kraatz.*
Bolitochara picta *Fauv.*
Heterothops pusio *Lec.*
Philonthus asper *Horn.*
  quadricollis *Horn.*
  microphthalmus *Horn.*
  sordidus *Grav.*
  inquietus *Erich.*
  serpentinus *Horn.*
  micans *Grav.*
Xantholinus gularis *Lec.*

* "A revised list of Coleoptera observed near Cincinnati, O."—This Journal. Vol. XX, No. 3, Art. V.

Lathrobium pallidulum *Lec.*
Leptolinus rubripennis *Lec.*
Gastrolobium carolinum *Er.*
Hesperobium sellatum *Lec.*
  cribratum *Lec.*
Scopæopsis duryi *Casey.*
Stilicus opaculus *Lec.*
Sciocharella n. sp.
  near delicatula
Sciocharis carolinenis *Csy.*
Leptogenius brevicornis *Csy.*
Sunius brevipennis *Auct.*
  prolixus *Er.*
  discopunctatus *Say.*
Tachinus nitiduloides *Horn.*
  repandus *Horn.*
  fimbriatus *Grav.*
Tachyporus nanus *Er.*
  elegans *Horn.*
Conosoma knoxii *Lec.*
  pubescens *Payk.*
Boletobius axilaris *Grav.*
  quæsitor *Horn.*
Mycetoporus lucidulus *Lec.*
  lepidus *Er.*
Oxytelus exiguus *Er.*
Lispinus linearis *Er.*
Nototaphra lauta *Casey.*
Atheta (near sordida *Melsh.*)
Anthobium convexum *Fauv.*
Eleusis canadensis.

TRICHOPTERYGIDÆ.

Ptinidium evanescens *Marsh.*
  lineatum *Lec.*
Ptinellodes lecontei *Matth.*

SCAPHIDIIDÆ.

Bæocera apicalis *Lec.*
  abdominalis *Csy.*

PHALACRIDÆ.

Severalunidentified species

CORYLOPHIDÆ.

Sacium misellum *Lec.*
Corylophodes marginicollis *Lec.*
Orthoperus micros *Casey.*

COCCINELLIDÆ.

Hyperaspis punctatus *Melsh.*

ENDOMYCHIDÆ.

Symbiotes pygmæus *Gohr.*
  sp.
Anamorphus pusillus *Zimm.*

EROTYLIDÆ.

Languria uhleri *Horn.*
Acropteroxys lecontei *Cr.*

COLYDIIDÆ.

Synchita laticollis *Lec.*

CRYPTOPHAGIDÆ.

Henoticus serratus *Gyll.*
Cryptophagus acutangulus *Gyll.*
  n. sp.
Cænoscelis obscura *Casey.*

MYCETOPHAGIDÆ.

Mycetophagus subdepressus *Csy.*

DERMESTIDÆ.

Cryptorhopalum triste *Lec.*

NITIDULIDÆ.

Brachypterus urticæ *Fab.*
Cercus pennatus *Murr.*
Carpophilus melanopterus *Er.*
Epuræa planulata *Er.*

LATHRIDIIDÆ.

Holoparamecus caularum *Aubé.*
Corticaria ferruginea *Marsh.*
  elongata *Gyll.*
Cartodere costulata *Reit.*
Melanophthalma longipennis *Lec.*

DASCYLLIDÆ.

Eucinetus strigosus *Lec.*

ELATERIDÆ.

Microrrhagus imperfectus *Lec.*

Adelothyreus dejeani *Bonv.*
Nematodes collaris *Bonv.*
Hylochares nigricornis *Say.*
Esthesopus claricollis *Say.*
Cryptohypnus choris *Say.*
  melsheimeri *Horn.*
  cucullatus *Horn.*
Hypnoides striatulus *Horn.*
Elater collaris *Say.*
  pusio *Germ.*
  insignis *Lec.*
Drasterius amabilis *Lec.*
Agriotes insanus *Cand.*
Dolopius lateralis *Esch.*
Limonius plebejus *Say.*
  n. sp.
Athous cucullatus *Esch.*
Corymbites signaticollis *Melsh.*

THROSCIDÆ.

Alonothroscus calocerus *Bon.*

BUPRESTIDÆ.

Anthaxia flavimana *Gory.*
Agrilus n. sp.

MALACHIDÆ.

Pseudebæus apicalis *Say.*
Attalus melanopterus *Er.*

CLERIDÆ.

Hydnocera difficilis *Lec.*
Chariessa onusta *Say.*
Colyphus melanopterus *Dury.*

PTINIDÆ.

Ptinus falli *Pic.*
Oligomerus obtusus *Lec.*
Trichodesma klagesi *Fall.*
Hadrobregmus pusillus *Fall.*
Xyletinus harrisi *Fall.*
Lasioderma semirufum *Fall.*
Petalium seriatum *Fall.*
Eupactus obsoletus *Fall.*
atorama nigritulum *Lec.*
  vexatum *Fall.*
  gracile *Fall.*
  confusum *Fall.*
  dichroum *Fall.*
Dorcatoma dresdensis *Hbst.*
Protheca hispida *Lec.*
  puberula *Lec.*
Eutylistis intermedius *Lec.*
  incomptus *Lec.*
Cænocara bicolor *Germ.*
Ptilinus lobatus *Csy.*

BOSTRICHIDÆ.

Lichenophanes armiger *Lec.*
  angustus *Csy.*
Dinoderus porcatus *Lec.*

SPHINDIDÆ.

Eurysphindus hirtus *Lec.*

SCARABÆIDÆ.

Atænius lecontei *Har.*
Hoplia trifasciata *Say.*
Lachnosterna marginalis *Lec.*
  vehemens *Horn.*
  balia *Say.*

CERAMBYCIDÆ.

Romaleum rufulum *Hald.*
Neoclytus capræa *Say.*
Cacoplia pullata *Hald.*

CHRYSOMELIDÆ.

Crioceris asparagi *Linn.*
Exema conspersa *Mann.*
Griburius larvatus *Newm.*
Cryptocephalus leucomelas *Suffr.*
Metachroma pallida *Say.*
Neobrotica dorsata *Say.*
Galeruca pomonæ *Scop.*
Phædromus paradoxus *Melsh.*
Crepidodera nitens *Horn.*
  æsculi *Dury.*
Glyptina cyanipennis *Crotch.*
Phyllotreta lindahli *Dury.*
Chætocnema pulicaria *Cr.*
Cassida nigripes *Oliv.*

TENEBRIONIDÆ.

Merinus lævis *Oliv.*

Uloma mentalis *Horn.*
Lyphia ficicola *Muls.*
Arhenoplites viridipennis *Fabr.*

CISTELIDÆ.

Hymenorus discretus *Csy.*
Mycetochara rufipes *Lec.*

MELANDRYIDÆ.

Eustrophus confinis *Lec.*
brunneimarginatus *Dury.*
Hallomenus debilis *Lec.*

ANTHICIDÆ.

Xylophilus bruneipennis *Lec.*
melsheimeri *Lec.*
Anthicus currax *Champ.*

STYLOPIDÆ.

Acroschismus bowditchi *Pierce.*
duryi *Pierce.*
lugubris *Pierce.*

RHYNCHITIDÆ.

Rhynchites æratus *Say.*

CURCULIONIDÆ.

Exomias pellucidus *Boh.*
Apion segnipes *Say.*
nigrum *Hbst.*
pennsylvanicum *Boh.*
rostrum *Say*
Anthonomus gularis *Lec.*
elongatus *Lec.*
Piazorhinus pictus *Lec.*
Ceutorhynchus sericans *Lec.*
Cataspastus conspersus *Lec.*
Lymnobaris bracata *Csy.*
concurrens *Csy.*
Plesiobaris disjuncta *Csy.*

CALANDRIDÆ.

Pentarthrinus piceus *Csy.*

SCOLYTIDÆ.

Scolytus fagi *Walsh.*

INDEX.

*For *Coleoptera* not enumerated in this Index, see the special Index, pp. 191-196 Additions and Corrections on pp. 197-198, and Supplementary List, pp. 257-260.

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Vol. XX. No. 2. 5

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Vol. XX. No. 6.

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